

# Electron impact collision strengths in Si IX, Si X and Si XI

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Electron impact collision strengths among 560 levels of Si IX, 320 levels of Si X and 350 levels of Si XI have been calculated using the Flexible Atomic Code (FAC) of Gu (2003). Collision strengths  $\Omega$  at ten scattered electron energies covering an entire energy range, namely 10, 50, 100, 200, 400, 600, 800, 1000, 1500 and 2000 eV, are reported. Assuming a Maxwellian energy distribution, effective collision strengths  $\Upsilon$  are obtained at a finer electron temperature grids of 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 MK, which covers the typical temperature range of astrophysical hot plasma. Additionally, radiative rates  $A$  and weighted oscillator strengths  $gf$  are given for more possible transitions among these levels. Comparisons of our results with available predictions reported in earlier literatures are made, and the accuracy of the data is assessed. Most transitions exhibit a better agreement, whereas large differences in  $gf$  appear for a few cases, which are due to the different inclusion of configuration interaction in different theoretical calculations. In excitations among levels of ground and lower excited configurations, large discrepancies of  $\Upsilon$  maybe resulted from the consideration of resonance effects in earlier works.

## 1. INTRODUCTION

A wealth of high resolution spectra in UV, EUV and X-ray regions has been obtained for solar, stellar and other astrophysical sources by many space missions, such as *SOHO*, *Chandra* and *XMM-Newton*. Many of the observed emission lines are due to highly charged silicon ions (Si VII–Si XIV), as reported in literatures for Procyon and  $\alpha$  Centauri [1, 2]. For line identifications and spectral analyses, a complete list of lines including emission or absorption lines of highly charged silicon, is very necessary. This is available in the Chianti <sup>1</sup> and ATOMDB <sup>2</sup> data sets. However, the available data of atomic parameters is very limited for elements such as silicon, sulfur, argon and calcium. Moreover, the accuracy of the available data for these L-shell ions attracts attention because of the poor modelling for the astrophysical spectra [3]. Recently, Aggarwal et al. [4], Liang et al. [5] and Landi & Bhatia [6] performed the atomic data calculations of Ar L-shell ions with larger configuration interaction (CI). They listed energy levels, radiative rates, and/or collision strengths. Generally, more accurate results could be obtained by considering larger CI, as stated by Aggarwal et al. [4].

Although many calculations for the highly charged silicon ions have been performed in past decades, and the data is used extensively in present astrophysical modelling codes, such as Chianti and APEC. Yet the data is limited to low-lying energy levels. For electron impact collision strengths, almost all available data is confined to levels with  $n = 2$  configurations. Moreover, available theoretical data of radiative rates is also confined to allowed and inter-combination (E1) transitions alone. In addition, the data used by the Chianti and APEC codes is from different literatures. Here, we attempt to present a self-consistent, accurate and extensive data for highly charged Si ions. Additionally, to provide experimental support, many lines of Si VIII — XIII in the 40–80 Å soft X-ray range have been measured in an experiment of silicon target irradiated by intense femtosecond laser at the Institute of Physics, Chinese Academy of Sciences [7].

## 2. ENERGY LEVELS

This study adopts the flexible atomic code (FAC) developed by Gu [8, 9] to perform calculations of the structure and the  $e$ -ion interaction process. This code is a standard atomic structure code alike GRASP code of Dyall et al. [10], and available at the website <http://kipac-tree.stanford.edu/fac/>. A fully relativistic approach based on Dirac

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<sup>1</sup> <http://www.solar.nrl.navy.mil/chianti.html>

<sup>2</sup> <http://cxc.harvard.edu/atomdb/>

equation is used throughout the entire package. The specific configurations included, results obtained and accuracy achieved, are discussed below for each ion.

## 2.1 Si IX

In the work of Aggarwal [11], 46 low-lying energy levels and radiative rates among these levels for carbon-like ions including Si IX, were reported. An extensive CI was considered in this work, and better results were obtained when compared with earlier calculations. Yet only 46 levels belong to configurations of  $(1s^2)2s^22p^2$ ,  $2s2p^3$ ,  $2p^4$ , and  $2s^22p3l$ , were reported. In comparison with experimental values (NIST<sup>1</sup>), level energies agree within 2% except for two levels of  $2s^22p^2\ ^1D_2$  and  $\ ^1S_0$ . The Chianti code adopts an earlier calculation of Bhatia & Doschek [12], which also reported 46 levels, but less CI was considered. Besides atomic data such as the energy levels, radiative decay rates and collision strengths, this work also presented line intensities for some strong transitions by solving rate equations of level populations. Orloski et al. [13] (hereafter OTC99) performed the calculation of energy levels by including additional configurations, namely  $2s2p^23l$ . Further, the calculated energy levels were adjusted again by observed wavelengths using an interactive optimization procedure packaged in the program ELCALC [14].

In our study, energies of 560 levels belonging to 31 configurations of Si IX [namely,  $2s^22p^2$ ,  $2s2p^3$ ,  $2p^4$ ,  $2s^22p3l$ ,  $2s2p^23l$ ,  $2p^33l$  ( $l = s, p, d$ ),  $2s^22p4l'$ ,  $2s2p^24l'$ ,  $2s^22p5l'$ ,  $2s^22p6l'$  ( $l' = 0, 1, \dots, n-1$ )] are reported as listed in Table 1. In order to assess the accuracy, we also list the NIST data which is recognized the most reliable data so far, and other theoretical calculations. In comparison with available experimental values, present results are better than 2% for most levels. Though a less CI has been considered than the work of Aggarwal [11], present level energies show an excellent agreement with those reported by Aggarwal [11]. On the other hand, this indicates that the CI effect from other configurations is not distinct. The theoretical calculation of Bhatia & Doschek [12] also agree with experimental values except for the level  $2s2p^3\ ^5S_2$ . Its value is lower than the experimental one by  $\sim 8\%$ . By considering large CI, the level energy increases to  $1.3025\ Ryd$ , and agrees with experimental one within 2%. Results of Orloski et al. [13] had been adjusted by observed wavelengths, so their level energies are listed for comparison in Table 1. Fig.1-(a) visually illustrate such comparison. For those higher excited levels, the configuration mixing is very severe. So level designation and ordering are very difficult. And only a few levels can be obtained from NIST database, and some levels are labelled by question mark '?'. For these levels, we note that our results differ the experimental values by less than  $0.07Ryd$ . This suggest that a good agreement has been obtained. Aggarwal et al. [11] considered a larger CI in their calculation. Unfortunately, the higher excited levels have not been reported.

## 2.2 Si X

For this ion, 50 experimental level energies belonging to the  $2s^22p$ ,  $2s2p^2$ ,  $2p^3$ ,  $2s2p3l$  ( $l = s, p, d$ ),  $2p^23d$ ,  $2s^24d$ ,  $2s^25d$  and  $2s^26d$  configurations can be obtained from the NIST website. In the Chianti database, additional 75 theoretical energy levels belonging to configurations, namely  $2s^22p$ ,  $2s2p^2$ ,  $2p^3$ ,  $2s^23l$ ,  $2s2p3l$ ,  $2p^23l$  ( $l = s, p, d$ ), are compiled from earlier works. And different theoretical calculations from different atomic physicists have been included, such as Edlen [15], Zhang et al. [16, 17], and Sampson & Zhang [18]. Cavalcanti et al. [19] also reported some level energies belonging to  $2s^22p$ ,  $2p^3$ ,  $2s^23l$ ,  $2s2p3l$ ,  $2p^23l$ ,  $2s^24l$ ,  $2s2p4p$ ,  $2s2p4d$ ,  $2s^25d$ ,  $2s2p5p$  and  $2s2p5d$  configurations using a multi-configuration Hartree-Fock relativistic approach, and adjusted their results by observed wavelengths.

By considered a larger CI, we calculate the level energies of Si X, and 320 levels belonging to configurations of  $2s^22p$ ,  $2p^3$ ,  $2s^23l$ ,  $2s2p3l$ ,  $2p^23l$  ( $l = s, p, d$ ),  $2s^24l'$ ,  $2s2p4l'$ ,  $2s^25l'$ ,  $2s2p5l'$  and  $2s^26l'$  ( $l' = 0, 1, \dots, n-1$ ;  $n$  is main quantum number) are reported as listed in Table 2. For comparison, other available theoretical results and experimental ones are also presented.

An inspection of Table 2 indicates that present results show a good agreement with experimental values and other different predictions, which is visually displayed in Fig.1-(b). Some higher excited levels such as levels from the  $2s2p4l$  and  $2s2p5l$  configurations, were also reported by Cavalcanti et al. [19] (hereafter referring to CLT00), and these energy values were adjusted by observed wavelengths. A comparison with these results reveals that our results are better than 1% as shown by filled circle in Fig.1-(b). From Table 2, we found the differences are less than  $0.08\ Ryd$ .

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<sup>1</sup> [http://physics.nist.gov/cgi-bin/AtData/main\\_asd](http://physics.nist.gov/cgi-bin/AtData/main_asd)

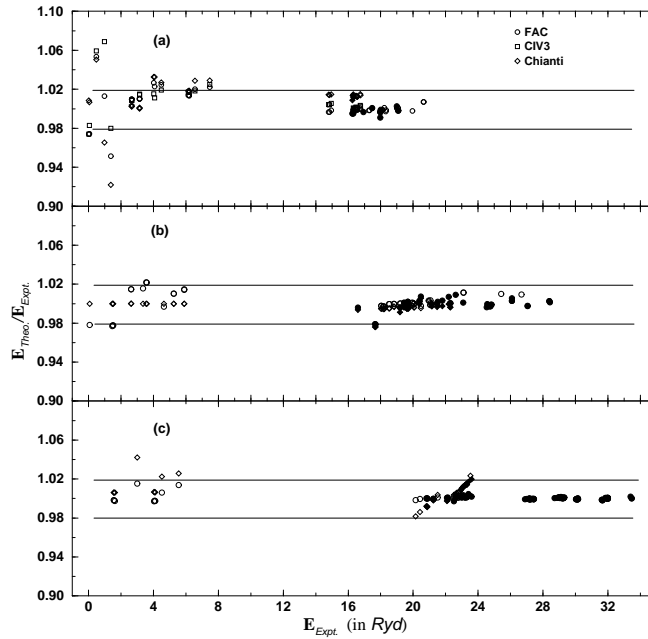


FIG. 1: Comparison of different calculations of energy levels versus the available experimental ones (from NIST database). The x-axis denotes the experimental energy (in *Ryd*), the y-axis denotes ratio of the theoretical calculations *vs* experimental ones. (a) for Si IX; (b) for Si X; (c) for Si XI.

### 2.3 Si XI

For this ion, almost all available theoretical results of energy levels are for low-lying 46 levels with  $n = 3$  configurations, which are extensively used by current astrophysical modelling codes such as Chianti, MEKAL and APEC. Typical studies are the works of Sampson et al. [20] and Zhang & Sampson [21]. Coutinho & Trigueiros [22] also reported higher excited levels of  $2s4l$ ,  $2p4l$ ,  $2s5l$  and  $2p5l$  configurations, in which a multi-configuration Hartree-Fock relativistic approach was adopted. The calculated energies were adjusted again by observed wavelengths using the interactive optimization procedure included in the ELCALC [14] program. In the newest version of NIST database, about 48 experimental energy levels belonging to the  $2s2p$ ,  $2p^2$ ,  $2s3l$ ,  $2p3l$ ,  $2s4l$ ,  $2p4p$ ,  $2p4d$ ,  $2s5d$  and  $2p5d$  configurations are listed. Here, we reported energies of 350 levels belonging to the 28 configurations of Si XI, namely  $2s^2$ ,  $2s2p$ ,  $2p^2$ ,  $2l3l'$ ,  $2l4l'$ ,  $2l5l'$ ,  $2l6l'$  and  $2l7l'$  ( $l = s, p; l' = 0, 1, \dots, n - 1$ ).

In Table 3 we list the level energies along with available experimental and theoretical compilations for a comparison. Present predictions show a good agreement with experimental ones for a majority of levels. Even for the lowest-lying levels of ground and lower excited configurations, the largest difference does not exceed 2%. Fig.1-(c) obviously indicates present results being better than the theoretical data included in the Chianti. For higher excited levels, we use the data of Coutinho & Trigueiros [22] to assess the accuracy, because Coutinho & Trigueiros [22] adjusted their results with observed wavelengths. A good agreement (within 0.3%) appears as shown by the filled circles in Fig.3-(c) and in Table 3.

## 3 WEIGHTED OSCILLATOR STRENGTH

We further reported the weighted absorption oscillator strength ( $gf_{ij}$ ) and radiative decay rate ( $A_{ij}$ ) for a given transition  $i \rightarrow j$  using the FAC package. In the following, we discuss our results of weighted oscillator strengths for each of the silicon ions in detail.

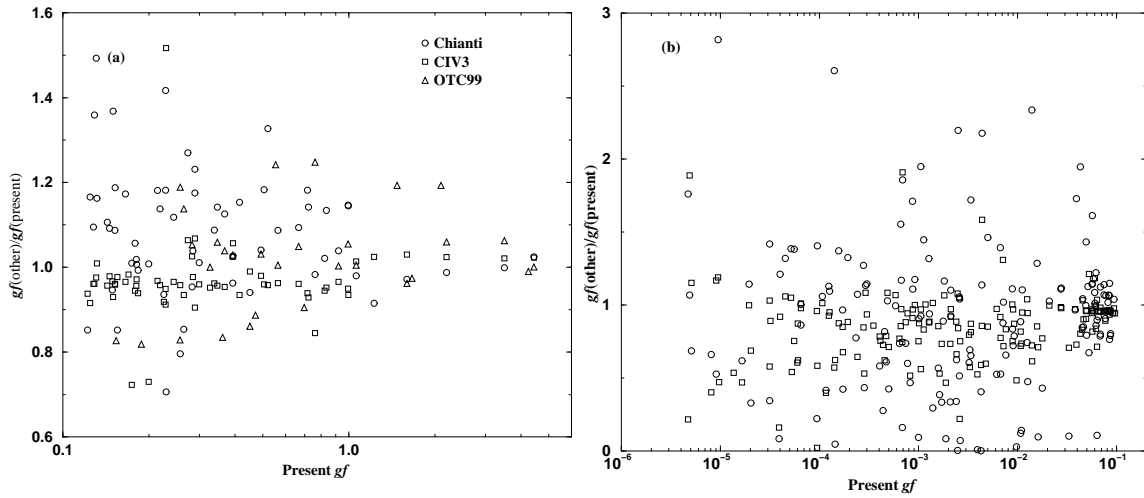


FIG. 2: Comparison of the Si IX weighted oscillator strengths from different calculations. The x-axis denotes the present results, the y-axis denotes ratio of other theoretical predictions *versus* present ones. (a) For strong transitions  $gf > 0.1$ , (b) For weak transition  $10^{-6} < gf < 0.1$ .

### 3.1 Si IX

Available theoretical data of radiative rates or weighted oscillator strengths was confined to transitions among 46 low-lying levels [11, 12] of Si IX. For strong or allowed transitions, the oscillator strengths are accurate to 10% as stated by Aggarwal [11] who adopted the CIV3 code [23]. However larger uncertainties still exist for those weak forbidden transitions ( $gf < 0.1$ ). In the work of Orloski et al. [13], weighted oscillator strengths ( $gf$ ) to higher excited levels of  $2s2p^23l$  configurations were also reported. In addition, a majority of literatures reported the radiative rates for electric dipole transitions among levels with  $n = 2$  complexes. To our best knowledge, no additional works reported the radiative rates or oscillator strengths for  $\Delta n \geq 1$  transitions among levels of  $n = 2, 3, 4$  and  $5$  complexes. In order to successfully modelling the astrophysical high-quality spectra, here we extend the data of the radiative rates. The  $gf$  and radiative rates for transitions among 560 levels were calculated as listed in Table 10. Not only the E1 type transitions are reported, but also other type transitions such as M1, E2 and M2, have been calculated, which directly results in the number of transitions increases by orders of magnitude.

In Table 4 we list some  $gf$ -values along with other available data of Aggarwal [11], Orloski et al. [13] and the data included in the Chianti database for a comparison. The Chianti code adopts results of Bhatia et al. [12] in the modelling of astrophysical spectra. A visual comparison is shown by Fig.2 for all available transitions. Because large CI has been considered by Aggarwal [11] and us, the two different calculations show a good agreement (within 20%) for most strong transitions ( $gf > 0.1$ ) as shown by square symbols in Fig.2-(a). Only three transitions such as  $2s^22p^2\ ^1D_2-2s^22p3d\ ^3F_2$  (4-38, numbers corresponding to level indices),  $2s^22p3p\ ^1P_1-2s^22p3d\ ^1D_2$  (25-40) and  $2s^22p3p\ ^3D_1-2s^22p3d\ ^3F_2$  (26-38), show differences of  $>20\%$ . Such differences are mainly due to the CI effect from another three configurations of  $3s3p$ ,  $3p3d$  and  $3d^2$  considered by Aggarwal [11]. We gradually considered the three configurations, the  $gf$  increases from 0.2293 to 0.3031 for  $2s^22p^2\ ^1D_2-2s^22p3d\ ^3F_2$  (4-38) transition, whereas it drops from 0.1995 and 0.1742 to 0.1454 and 0.1703 for  $2s^22p3p\ ^1P_1-2s^22p3d\ ^1D_2$  (25-40) and  $2s^22p3p\ ^3D_1-2s^22p3d\ ^3F_2$  (26-38) transitions, respectively. This reveals that the CI is the most possible reason for large uncertainties. The comparison with the data used by the Chianti code is displayed by open-circle symbols in Fig.2-(a). Though a less CI was considered in the work of Bhatia et al. [12], the two different data still agree within 20% for most strong transitions. Yet, for more transitions besides above three ones, the two different calculations differ beyond 20%. Additionally, the comparison with the results of Orloski et al. [13] is illustrated by up-triangle symbols in Fig.2-(a). For those weak transitions ( $gf < 0.1$ ), more transitions show large discrepancies between different calculations as shown in Fig.2-(b). We also test the reason for the large differences, and found that the CI effect is the main reason. Generally, present results agree with the results of Aggarwal [11], whereas a slightly poor agreement with the data included in the Chianti appears. The presence of large uncertainties suggests a scope of improvement.

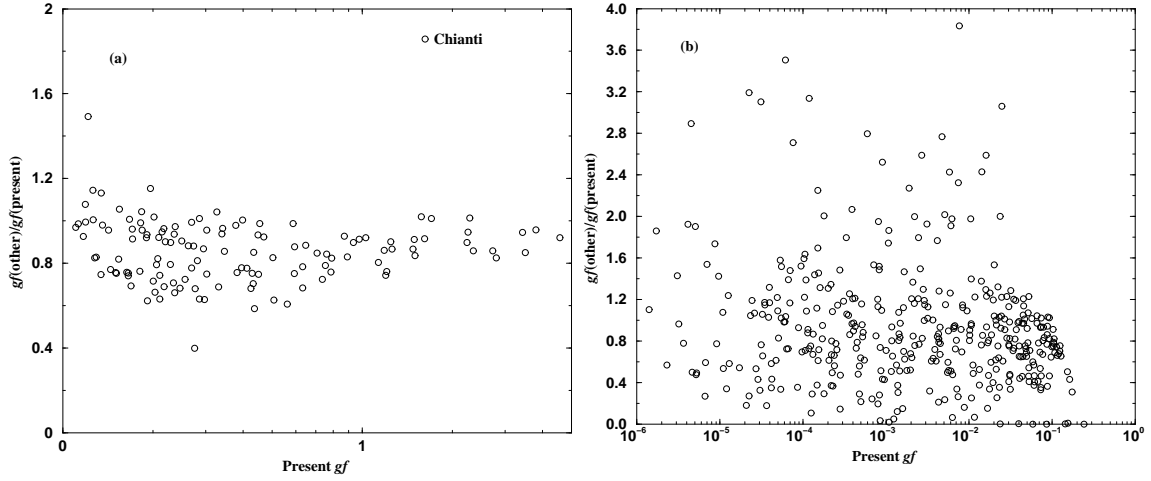


FIG. 3: Comparison of the Si X weighted oscillator strengths from different calculations. The x-axis denotes the present results, the y-axis denotes ratio of the data included by the Chianti *versus* present ones. (a) For strong transitions  $gf > 0.1$ , (b) For weak transition  $10^{-6} < gf < 0.1$ .

### 3.2 Si X

For B-like silicon, most available radiative rates or oscillator strengths of Si X are for transitions among the lowest 15 levels. The radiative rates from higher excited levels were firstly reported by Zhang & Sampson [16], which were extensively used in current astrophysical modelling codes, such as Chianti and APEC. Cavalcanti et al. [19] calculated the weighted oscillator strengths ( $gf$ ) using optimized electrostatic parameters for transitions among levels of the configurations, namely  $2s^22p$ ,  $2p^3$ ,  $2s^23l$ ,  $2s2p3l$ ,  $2p^23l$ ,  $2s^24l$ ,  $2s2p4p$ ,  $2s2p4d$ ,  $2s^25d$ ,  $2s2p5p$  and  $2s2p5d$ . In our study, we calculated the  $gf$  and radiative rates for transitions among 320 levels. By including other type transitions such as M1, E2 and M2, the number of transitions increases by orders of magnitude. These lost features in the astrophysical modelling codes might explain the disagreement of fitting in astrophysical X-ray spectral analyses. The results of  $gf$  and radiative rates  $A$  are listed in Table 11, along with effective collision strengths which will be discussed in the next section.

In Table 5 we compared our  $gf$ -values with other different predictions for some transitions. Fig.3 visually exhibits such comparison for all available transitions. Here we pay special attention on the comparison with the data used by the Chianti code. For most strong transitions, our results agree with predictions of Zhang & Sampson [16] within 20%. Fig.3-(a) clearly reveals that our results are systematically higher than predictions used by the Chianti. However, three strong transitions of  $2s2p^2\ ^4P_{3/2}-2s2p(^3P)3d\ ^2D_{5/2}$  (4–48),  $2s2p^2\ ^2D_{3/2}-2s2p(^3P)3d\ ^4D_{5/2}$  (7–45) and  $2p^3\ ^2P_{3/2}-2p^2(^3P)3d\ ^4D_{3/2}$  (15–44), display discrepancies being up to a factor of  $\sim 4$ . By gradually decreasing the configurations, we confirm that the large differences are mainly resulted from the CI effect of the  $2p^3$  configuration. When only configurations of  $2s^22p$ ,  $2s2p^2$ ,  $2s^23l$  and  $2s2p3l$  are considered, the  $gf$  increase from 0.085 and 0.054 to 0.404 and 0.126 for the  $2s2p^2\ ^4P_{3/2}-2s2p(^3P)3d\ ^2D_{5/2}$  (4–48) and  $2s2p^2\ ^2D_{3/2}-2s2p(^3P)3d\ ^4D_{5/2}$  (7–45) transitions, respectively, they show a good agreement with the values of the Chianti. But the  $gf$  rapidly decrease to 0.117 and 0.052 again, when the  $2p^3$  configuration has been included. For the  $2p^3\ ^2P_{3/2}-2p^2(^3P)3d\ ^4D_{3/2}$  (15–44) transition, the large difference is due to the CI effect among the  $n = 3$  complexes. When only the  $2p^23d$  configuration of the  $n = 3$  complexes has been included, the  $gf$  is 0.1136 which agrees well with the adopted data (0.1099) by the Chianti. When another two related  $3d$ -complexes such as  $3s^23d$  and  $2s2p3d$  have been included, the value increases to 0.1225. The  $gf$  value steadily increases to 0.1978 when other  $n = 3$  complexes have been included. Therefore, the large differences between present results and other different theoretical predictions, are due to the CI effect. For those weak transitions ( $gf < 0.1$ ), more transitions show large discrepancies between different calculations as shown in Fig.3-(b). The differences are even up to an order of magnitude for a few transitions, which leaves a scope of improvement.

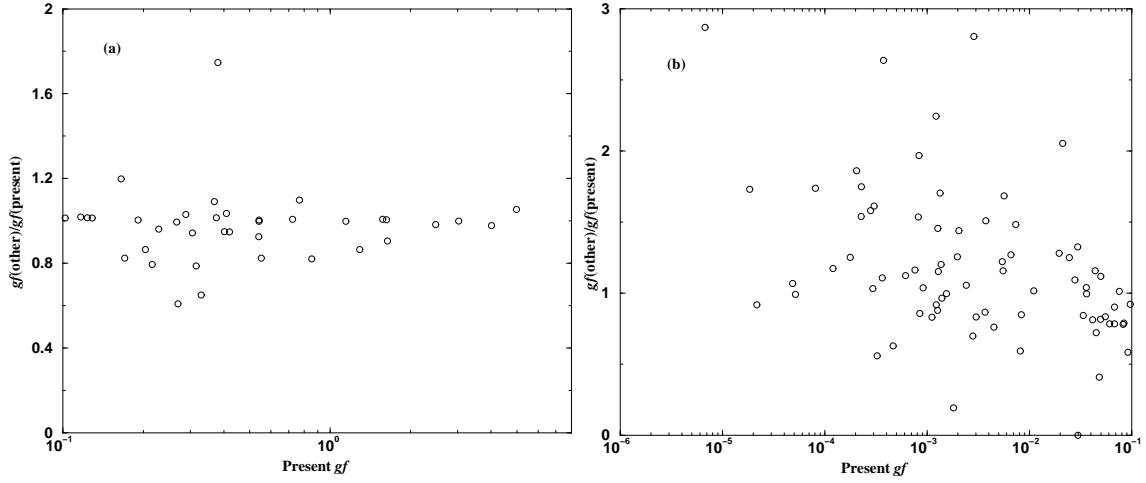


FIG. 4: Comparison of the Si XI weighted oscillator strengths from different calculations. The x-axis denotes the present results, the y-axis represents ratio of the data included by the Chianti *versus* present ones. (a) For strong transitions  $gf > 0.1$ , (b) For weak transition  $10^{-6} < gf < 0.1$ .

### 3.3 Si XI

In the Chianti database, the  $gf$  of electric dipole allowed transitions of Si XI are included for transitions among 46 levels belonging to the  $2s^2$ ,  $2s2p$ ,  $2p^2$ ,  $2s3l$  and  $2p3l$  configurations. These data was from study of Sampson et al. [20] who adopted the DFS code developed by them [24]. Coutinho et al. [22] also performed the calculation of the  $gf$  by including another configurations of  $2s4l$ ,  $2p4l$ ,  $2s5l$  and  $2p5l$ . In our study, the  $gf$  and radiative rates for transitions among 350 levels were calculated. By including other type transitions such as M1, E2 and M2, the number of transitions increases by orders of magnitude relative to available data. The radiative decay rates to higher excited levels such as levels of  $2l3l'$  configurations, have also been obtained. These data could be used to investigate cascade effects to higher levels, which may be important in the high-density laser-produced plasma. The results of  $gf$  and radiative rates  $A$  are listed in Table 12.

In Table 6 we compare our results with the data used by the Chianti code and the results of Coutinho & Trigueiros [22] for some transitions. A visual comparison for all available transitions is illustrated by Fig.4. For strong transitions ( $gf > 0.1$ ), present predictions agree with the data used by Chianti code within  $\sim 20\%$ . But three transitions such as  $2s^2 \ ^1S_0 - 2s3p \ ^3P_1$  (1–15),  $2s2p \ ^1P_1 - 2p3p \ ^1S_0$  (5–25) and  $2s2p \ ^1P_1 - 2p3p \ ^3P_0$  (5–44), differ up to  $\sim 70\%$ . By gradually decreasing the configurations, we find that the large difference is still present for the  $2s^2 \ ^1S_0 - 2s3p \ ^3P_1$  (1–15) transition, and our prediction is always significantly lower than the value used by the Chianti when the  $2p3l$  complexes are included. However, the  $gf$  becomes being higher than the later case by a factor of  $\sim 5$  without the  $2p3l$  complexes. In the work of Sampson et al. [20], they explain that the large difference of collision strength  $\Omega$  to be a level mixing of  $^1P_1$  and  $^3P_1$ . Whether the same behavior occurs for the weighted oscillator strength  $gf$ . We found that the sum  $gf$  of the two transitions  $2s^2 \ ^1S_0 - 2s3p \ ^1P_1$  (1–13) and  $2s^2 \ ^1S_0 - 2s3p \ ^3P_1$  (1–15), are 0.6068 and 0.6130 for above two cases, and this agree with the sum  $gf$  (0.5642) of Chianti within 10%. In this study, the sum  $gf$  is 0.5892, which also agrees with that of Chianti. Therefore the level mixing and CI maybe the possible reasons of the large differences. For those weak transitions ( $gf < 0.1$ ), more transitions show large discrepancies between different calculations as shown in Fig.4-(b). The large differences may be from the CI effect without considered, which leaves a scope of improvement.

## 4 COLLISION STRENGTH $\Omega$ AND EFFECTIVE COLLISION STRENGTH $\Upsilon$

In this study, a self-consistent electron impact collision strengths  $\Omega$  has been calculated at scattered electron energies ranging from 4 to 10000 eV being cover the entire energy range. In Table 7–9, we list the  $\Omega$  at ten scattered electron energy points such as 10, 50, 100, 200, 400, 600, 800, 1000, 1500 and 2000 eV. In practical applications, effective collision strengths appear more important. Assuming a Maxwellian distribution for the thermal electrons,

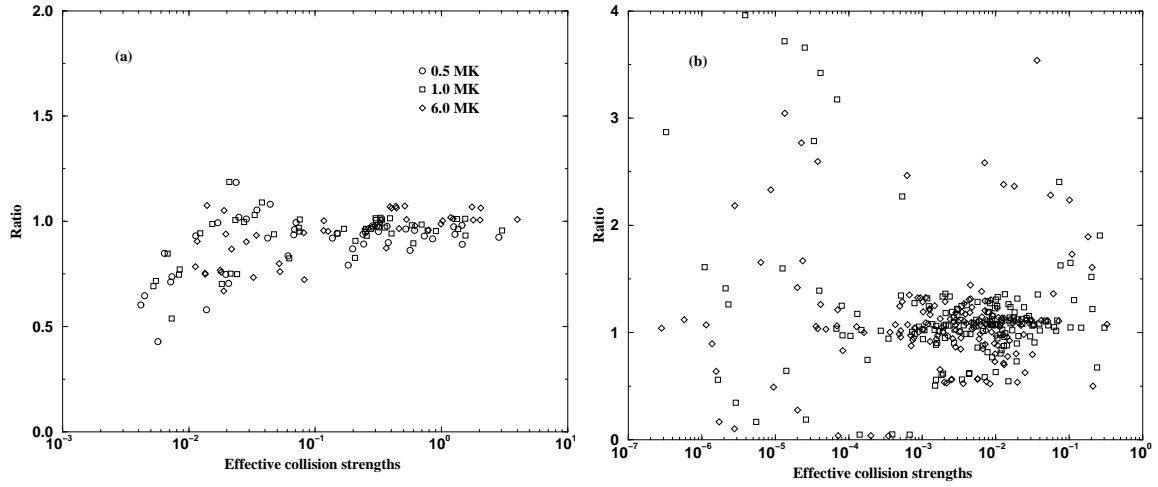


FIG. 5: Comparison of the effective collision strengths  $\Upsilon$  of Si IX for different calculations. The x-axis denotes the present  $\Upsilon$ , the y-axis denotes ratio of the data used by the Chianti code *versus* present ones. (a) allowed transitions, while (b) other type transitions.

the effective collision strengths are derived through numerical integration,

$$\Upsilon_{ij} = \int_0^\infty \Omega_{ij} \exp\left(-\frac{E}{kT_e}\right) d\left(\frac{E}{kT_e}\right),$$

where  $E$  is the scattered electron energy,  $k$  is the Boltzmann constant, and  $T_e$  is the electron temperature. Correspondingly, the excitation rate coefficients (in  $\text{cm}^3\text{s}^{-1}$ ) used in the statistical equilibrium to derive the level populations, can be obtained directly from the effective collision strength

$$C_{ij} = \frac{8.63 \times 10^{-6}}{\omega_i T_e^{1/2}} \exp\left(\frac{-E_{ij}}{kT_e}\right) \Upsilon_{ij},$$

where  $E_{ij}$  is the energy difference between levels  $i$  and  $j$ , and  $\omega_i$  is the statistical weight of level  $i$ . In the following, we present our results of (effective) collision strengths for each ions in detail, and make an assessment through comparison with published data.

#### 4.1 Si IX

In the Chianti database, only limited excitation data among the lowest 46 levels is available for Si IX, and the data are taken from work of Bhatia & Doschek [12] who reported values at three incident electron energies of 20, 40 and 60 *Ryd*. The work of Aggarwal & Baluja [25] for forbidden transitions is also included. Aggarwal & Baluja [25] adopted a more accurate approach— $R$ -matrix [26] to derive the excitation data, so far, which is the best reliable data for this ion, because coupling effects among different channels have been considered. But only the excitations among levels with  $n = 2$  complexes were reported. A much earlier work is performance of Mason & Bhatia [27] who calculated the excitation data among the lowest 20 levels using the distorted wave approximation (DWA). To our knowledge, the latest work of the collision strengths for carbon-like Si is results of Zhang & Sampson [28], yet only  $\Delta n = 0$  DWA excitation data within  $n = 2$  configurations is available. Here we present a self-consistent excitation data for a large amount of transitions.

In Table 10, we present the effective collision strengths for excitations from lowest 20 levels to higher levels up to 560-th level at seven temperatures: 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 MK. Moreover the weighted oscillator strengths ( $gf$ ) and radiative rates ( $A$ ) are listed in this table. The indices used to represent the lower and upper levels of a transition have already been defined in Table 1.

We pay a special attention on the comparison with the data used by the Chianti code. In Table 13, the  $\Upsilon$  is given for some transitions at three temperatures of 0.5, 1.0 and 6.0 MK. The comparison with all available  $\Upsilon$  is shown by Fig.5. Fig.5-(a) illustrates the comparison for allowed transitions, while Fig.5-(b) displays the comparison for other type transitions. For the allowed transitions, present results of  $\Upsilon$  are systematically higher than the data used by

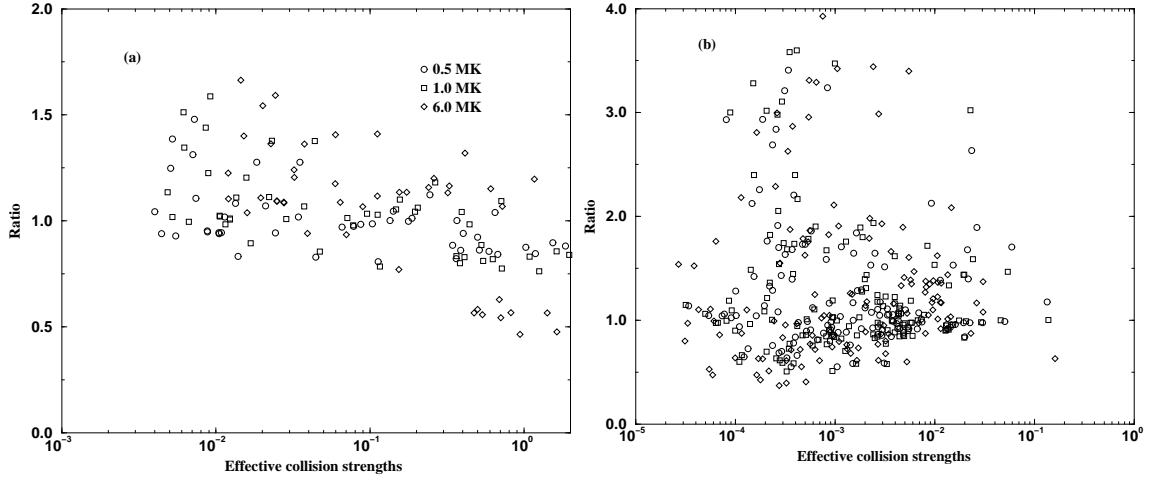


FIG. 6: Comparison of the effective collision strengths  $\Upsilon$  of Si X for different calculations. The x-axis denotes the present  $\Upsilon$ , the y-axis denotes ratio of the data used by the Chianti code *versus* present ones. (a) allowed transitions, while (b) other type transitions.

the Chianti code slightly, yet they agree within  $\sim 20\%$  except for a few excitations to the levels of  $2s^2 2p^3 s$  such as  $2s^2 2p^2 \ ^3P_0 - 2s^2 2p^3 s \ ^3P_1$  (1–22),  $2s^2 2p^2 \ ^3P_1 - 2s^2 2p^3 s \ ^3P_0$  (2–21) and  $2s^2 2p^2 \ ^1D_2 - 2s^2 2p^3 s \ ^1P_1$  (4–24), in which the differences are up through to 50%. For these transitions, the  $gf$  differs  $\sim 30\%$  between the two different theoretical calculations. Discussions in Sect. 2.1 have indicated that the CI maybe the possible reason. For forbidden transitions, we note that the discrepancies are even higher up to factors of  $\sim 1.5$ –9. The  $\Upsilon$  of the Chianti is systematically higher than present results for excitations up through to the level of  $2p^4 \ ^1S_0$ . And the differences can reach up to  $\sim 4$  times in some cases such as  $2s^2 2p^2 \ ^3P_0 - 2s^2 2p^2 \ ^3P_1$  (1–2),  $2s^2 2p^2 \ ^3P_0 - 2s^2 2p^2 \ ^3P_2$  (1–3),  $2s^2 2p^2 \ ^3P_1 - 2s^2 2p^2 \ ^3P_2$  (2–3), etc. This is due to the consideration of resonant excitations in the calculation of Aggarwal & Baluja [25] who adopted the  $R$ -matrix method. In some forbidden transitions from much higher excited levels ( $> 20$ ), we also note the discrepancies being up to an order of magnitude, such as  $2s 2p^3 \ ^3D_3 - 2s^2 2p^3 p \ ^3S_1$ ,  $^3P_{1,2}$  (7–29, 31, 32). Such differences follow the discrepancies in the relevant  $gf$ , in which the CI effect gives rise to the large differences. However for most forbidden excitations, present  $\Upsilon$  is in agreement with the data used by the Chianti code. This discussion indicates that there is a scope of improvement by consideration of resonant effect and much more CI effect.

#### 4.2 Si X

So far, only two literatures reported  $\Omega$  and/or  $\Upsilon$  of  $n = 2$ –3 excitations, one is the work of Zhang & Sampson [16] using relativistic DW approximation, the other is an unpublished calculation of Sampson & Zhang [18]. The two calculations are extensively used by present astrophysical modelling. Zhang et al. [17] had adopted  $R$ -matrix approach to calculate the  $\Omega$ , whereas their calculation is confined to transitions among 15 fine-structure levels belonging to 8 LS terms  $2s^2 2p(^2P_{1/2,3/2}^0)$ ,  $2s 2p^2(^4P_{1/2,3/2,5/2}, ^2D_{3/2,5/2}, ^2S_{1/2}, ^2P_{1/2,3/2})$ ,  $2p^3(^4S_{3/2}^0, ^2D_{3/2,5/2}^0, ^2P_{1/2,3/2}^0)$ , and only partial data was reported. Recently, Keenan et al. [29] re-calculated these data again using  $R$ -matrix method, and listed all these data at much finer temperature grids. These excitation data was widely used by current astrophysical modelling codes such as Chianti, MEKAL and APEC codes. However a poor modelling for emissions of highly charged Si in the astrophysical spectral analysis, is still existed [3, 30]. As stated in these literatures, uncertainties of the excitation data is the main possible source of the poor modelling. In our present work, a self-consistent calculation is reported for the collision strength at ten scattered electron energies as listed in Table 8. Assuming the Maxwellian energy distribution, averaged collision strengths ( $\Upsilon$ ) at seven temperatures are listed in Table 11 for excitations from lowest 15 levels. The indices used to represent the lower and upper levels for a given transition have already been defined in Table 2.

In Table 14, we compare our  $\Upsilon$  with the data used by the Chianti code at three temperatures of 0.5, 1.0 and 6.0 MK, which are typical temperatures of stellar X-ray emitters. The comparison with all available  $\Upsilon$  is illustrated in Fig. 6. Fig. 6-(a) represents the allowed transitions, while Fig. 6-(b) shows the comparison for other type transitions. For most allowed transitions, present results of  $\Upsilon$  agree with the data included in the Chianti data sets within 20%, yet



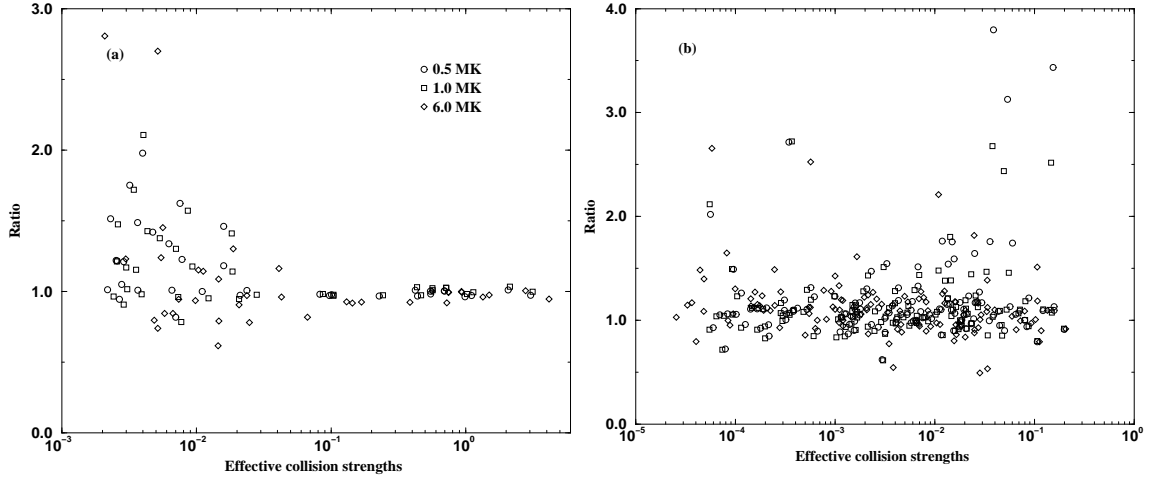


FIG. 7: Comparison of the effective collision strengths  $\Upsilon$  of Si XI for different calculations. The x-axis denotes the present  $\Upsilon$ , the y-axis denotes ratio of the data used by the Chianti code *versus* present ones. (a) allowed transitions, while (b) other type transitions.

differences up to 50% are also apparent, such as excitations of  $2s^2 2p^2 P_{1/2} - 2s 2p^2 D_{3/2}$  (1-7),  $2s^2 2p^2 P_{3/2} - 2s 2p^2 D_{5/2}$  (2-6), etc. We found that the large differences occur for excitations up through to the level of  $2s 2p^3 P_{3/2}$ . And at higher temperature, the differences are more clear. In the Chianti database, the work of Zhang et al. [17] is used for these excitations, who adopted  $R$ -matrix method by accounting for the resonant effect. So we believe the large differences are resulted from the resonant effect. For those forbidden transitions, more excitations exhibit large differences. And in some cases, the discrepancies are up through to factors of  $\sim 4$ . Such phenomena is natural, because the resonant excitations generally is more obvious. For example,  $2s^2 2p^2 P_{3/2} - 2s 2p^2 P_{1/2}$  (2-3), the result of Zhang et al. [17] is higher than present one by a factor of  $\sim 2$ . While for an allowed transition of  $2s^2 2p^2 P_{1/2} - 2s 2p^2 S_{1/2}$  (1-8), the difference is less than 20%. In addition, the CI effect is another important reason for the large differences, such as for  $2s 2p^2 P_{3/2} - 2s 2p(^3P) 3d^2 D_{5/2}$  (4-48) and  $2s 2p^2 P_{3/2} - 2p^2(^3P) 3s^2 P_{1/2}$  (4-70). However, such differences follow the discrepancies of the relevant  $gf$ . In the Sect.2.2, we distinguish the large differences are from the CI effect of the configuration  $2p^3$ . This comparison also indicates that the improvement by considering the resonance excitation and more CI effect, is very necessary.

#### 4.3 Si XI

For this ion, only limited electron impact excitation data among the lowest 46 levels is available so far, and all excitation data was calculated using DW approximation. Yet most available  $\Omega$  is confined to transitions with  $\Delta n = 0$ . To our best knowledge, only one work performed the calculation for  $\Delta n = 1$  transitions, and it is a work about two decades ago [20]. These data is still used by the Chianti code. In this study, self-consistent results of  $\Omega$  and  $\Upsilon$  of excitations from lowest 10 levels, are reported for Si XI as shown in Table 9 and 12 respectively. The reported  $\Upsilon$  covers the typical coronal temperature range of  $\sim 0.1$ –10 MK. The indices used in tables to represent the lower and upper levels of a transition have already been defined in Table 3.

In Table 15, a comparison of our  $\Upsilon$  with the data used by the Chianti code at three temperatures is given for partial transitions. The comparison with all available  $\Upsilon$  is also illustrated through Fig.7. Fig.7-(a) illustrates the comparison for allowed transitions at three temperatures of 0.5, 1.0 and 6.0 MK, while Fig.7-(b) shows the comparison for other type transitions. For the allowed transitions, the two different calculations show a better agreement except for a few transitions such as  $2s^2 ^1S_0 - 2p 3s^3 P_1, ^1P_1$  (1-22, 24), and  $2s^2 ^1S_0 - 2p 3d^3 D_1$  (1-38). In these cases, the differences are up to a factor of  $\sim 4$ , and they follow the differences in  $gf$ . The discussion in Sect.2.3 indicates the discrepancies in  $gf$  are due to the level mixing and CI effect. For other type transitions, a majority of transitions shows a good agreement at temperature of  $\sim 0.1$ –6 MK, whereas large differences are also present for some transitions. The interpretation for the large discrepancies can be divided into two group, one is due to the different data sources in the Chianti data sets. For excitations among the low-lying 10 levels, the work of Berrington et al. [31] is used, who considered the resonant effect by using the  $R$ -matrix approach. So the  $\Upsilon$  of the Chianti is larger than present ones by factors of up through to  $\sim 3$ . The other possible reason maybe from the different inclusions of CI, such as for  $2s^2 ^1S_0 - 2p 3s^3 P_1$  (1-22).

The difference also follows the discrepancy in relevant  $gf$ . This leaves a scope of improvement by considerations of resonance effect and much more CI effect.

## 5 CONCLUSIONS

In this work, radiative rates and oscillator strengths  $gf$  among 560, 320 and 350 levels of Si IX, Si X and Si XI are reported, respectively. A self-consistent calculation of (effective) collision strengths is performed with large CI using the fully relativistic FAC code of Gu [8]. In general, our energy levels agree with the available experimental values within 2%. For strong transitions ( $gf > 0.1$ ), present results of radiative rates or weighted oscillator strengths show a good agreement with available data except for a few transitions with discrepancies of several times. By gradually decreasing the CI, we found that the relatively large differences can be diminished, which indicates CI plays an important role in accurate determinations of  $gf$ . For weak transitions ( $gf < 0.1$ ), the CI effect appears more obvious. And the discrepancies can reach up to an order of magnitude in some cases.

Self-consistent collision strengths and effective collision strengths by considering large CI are also reported in this study. For allowed transitions, present work shows a better agreement with available data except for a few excitations, in which the differences are up to factor of  $\sim 3$ . Such differences follow the discrepancies of  $gf$ , which reveals the large differences maybe from the CI effects. Though the present  $\Upsilon$  agree with the data of the Chianti within 20% for a majority of forbidden transitions, a certain of excitations show large differences up to  $\sim 4$ , which can be attributed to the resonant effect and CI effect in the different calculations, because the excitation data among levels of  $n = 2$  complexes in the Chianti data sets was from  $R$ -matrix method. The discussion also implies that there is a scope of improvement by considering the resonant effect and more CI effect.

## ACKNOWLEDGMENTS

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TABLE IV: Comparison of weighted oscillator strength  $gf_{ji}$  (written in form  $a \pm b$  implying  $a \times 10^{\pm b}$ ) for some transitions of Si IX.  $i$  and  $j$  are denoted in Table I. OTC99 represents the work of Orloski et al. [13].

$i$	$j$	FAC	CIV46	Chianti	OTC99	$i$	$j$	FAC	CIV46	Chianti	OTC99
1	9	8.160-2	7.797-2	8.310-2	7.797-2	3	38	1.251-2	1.301-2	9.310-3	1.301-2
1	11	7.759-2	7.444-2	8.260-2	7.444-2	3	39	4.623-2	4.170-2	3.930-2	4.170-2
1	14	9.369-2	9.154-2	9.750-2	9.154-2	3	40	5.010-3	4.274-3	7.330-3	4.274-3
1	22	6.791-2	6.494-2	5.360-2	6.494-2	3	42	6.889-4	1.315-3	1.280-3	1.315-3
1	24	6.702-4	6.514-4	7.840-4	6.514-4	3	43	7.678-2	6.860-2	6.970-2	6.860-2
1	42	1.061+0	1.076+0	1.040+0	1.076+0	3	44	3.494+0	3.566+0	3.490+0	3.566+0
1	46	6.041-2	7.154-2	6.120-2	7.154-2	3	46	3.925-1	4.024-1	3.780-1	4.024-1
1	51	3.298-3	1.901-3	2.290-3	1.901-3	3	51	1.159-4	4.620-5	4.830-5	4.620-5
2	6	1.950-5	1.947-5	2.230-5	1.947-5	3	52	5.868-4	6.265-4	5.840-4	6.265-4
2	8	1.805-1	1.726-1	1.840-1	1.726-1	4	7	8.741-4	8.480-4	9.700-4	8.480-4
2	9	4.883-2	4.707-2	4.870-2	4.707-2	4	10	9.522-5	5.560-5		5.560-5
2	13	1.066-4	1.080-4	1.130-4	1.080-4	4	11	3.012-4	2.822-4	3.450-4	2.822-4
2	15	1.274-3	1.122-3	1.680-3	1.122-3	4	14	1.408-4	8.050-5	3.670-4	8.050-5
2	21	6.865-2	6.579-2	5.500-2	6.579-2	4	23	1.053-3	1.022-3	9.750-4	1.022-3
2	38	2.601-3	5.754-4	2.710-3	5.754-4	4	39	1.070-2	8.760-3	9.490-3	8.760-3
2	40	4.477-2	3.726-2	3.790-2	3.726-2	4	42	7.740-4	7.310-4	4.650-4	7.310-4
2	42	3.934-1	4.158-1	4.040-1	4.158-1	4	46	9.187-4	9.190-4	1.080-3	9.190-4
2	47	2.831-1	2.905-1	2.700-1	2.905-1	5	11	1.567-4	1.372-4	2.150-4	1.372-4
2	51	2.416-3	1.601-3	1.510-3	1.601-3	5	14	1.931-4	1.709-4	2.560-4	1.709-4
3	6	4.506-5	4.774-5	5.950-5	4.774-5	5	15	1.808-1	1.757-1	1.820-1	1.757-1
3	13	2.115-3	1.948-3	2.330-3	1.948-3	5	22	1.009-3	8.839-4	9.140-4	8.839-4
3	14	4.928-1	4.828-1	5.130-1	4.828-1	5	24	8.495-2	7.945-2	6.500-2	7.945-2
3	22	8.687-2	8.330-2	6.990-2	8.330-2	5	42	4.260-3	2.513-3	1.730-3	2.513-3
3	23	2.574-1	2.465-1	2.050-1	2.465-1	5	46	7.403-4	6.538-4	5.470-4	6.538-4
3	24	2.782-4	2.357-4	3.540-4	2.357-4	5	51	1.224+0	1.254+0	1.120+0	1.254+0

TABLE V: Comparison of weight oscillator strength ( $gf$ ) for some transitions of Si X. CLT00 refers to the work of Cavalcanti et al. [19].

$i$	$j$	FAC	CLT00	Chianti	$i$	$j$	FAC	CLT00	Chianti
1	7	1.421-1		1.360-1	4	21	1.500-1		1.134-1
1	8	1.126-1		1.110-1	4	45	2.807+0	2.380+0	2.316+0
1	9	1.900-1	1.840-1	1.750-1	4	53	8.366-4		2.357-4
1	16	5.113-2		4.013-2	4	56	5.504-4		3.396-4
1	19	1.246+0	1.300+0	1.124+0	4	74	1.172-3		9.430-4
1	28	1.200-1	1.870-1	8.156-2	4	82	5.016-2		4.633-2
1	59	5.940-4		1.661-3	5	25	5.520-5		8.375-5
1	144	4.307-2	8.930-2		5	45	2.558-1	6.400-3	
2	6	2.373-1	2.320-1	2.040-2	5	49	1.575+0	1.900+0	1.606+0
2	9	1.545-1	1.570-1	1.630-1	5	66	3.527-4		3.698-4
2	10	5.872-1	5.820-1	5.800-1	5	84	7.944-4		9.566-4
2	20	2.240+0	2.330+0	2.011+0	7	12	4.551-2		4.430-2
2	192	1.928-1	1.880-1		7	13	4.547-1	4.580-1	4.490-1
3	21	3.023-2		2.279-2	7	52	8.013-2	1.500-2	6.685-2
3	38	4.486-3		4.188-3	7	54	2.256+0	2.120+0	2.136+0
3	44	1.258+0	1.300+0	1.091+0	8	12	7.510-3	7.800-1	
3	51	3.880-2		3.795-2	8	53	1.689-1		1.171-1
3	74	4.216-4		5.116-4	8	107	6.846-3		4.965-3

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TABLE VI: Comparison of weight oscillator strength ( $gf$ ) for some transitions of Si XI. CT01 refers to the work of Coutinho & Trigueiros [22].

$i$	$j$	FAC	CT01	Chianti	$i$	$j$	FAC	CT01	Chianti
1	5	2.666-1		2.652-1	4	8	3.755-1	4.010-1	3.809-1
1	13	5.533-1		4.557-1	4	11	1.702-1	1.620-1	1.403-1
1	15	3.592-2		1.085-1	4	17	3.620-2		3.607-2
1	22	3.744-4		9.865-4	4	18	5.418-1		5.409-1
2	7	1.020-1	1.090-1	1.034-1	4	31	1.651-1	1.730-1	2.003-5
2	17	7.234-1	7.120-1	7.291-1	4	32	3.683-1	3.730-1	4.017-1
2	29	4.403-2		5.090-2	4	73	1.180-1	1.100-1	
2	53	1.342-1	1.300-1		4	68	1.623-1	1.590-1	
3	7	7.572-2	8.080-2	7.679-2	4	107	2.096-1	1.970-1	
3	8	1.286-1	1.370-1	1.304-1	4	125	1.209-1	1.040-1	
3	17	5.423-1		5.446-1	5	9	2.881-1	3.050-1	2.969-1
3	18	1.625+0	1.600+0	1.634+0	5	10	1.913-1	2.340-1	1.922-1
3	27	2.283-1	2.380-1		5	12	4.144-2		3.368-2
3	29	1.166-1	1.200-1	1.187-1	5	20	1.638+0	1.670+0	1.482+0
3	32	9.849-2	1.000-1	1.046-1	5	37	7.681-1	7.390-1	8.435-1
3	37	1.226-3		1.128-3	5	44	8.528-2	8.600-1	
3	54	3.016-1	2.930-1		5	56	3.629-1	3.620-1	
3	106	1.127-1	1.060-1		5	77	1.622-1	1.600-1	
4	7	1.235-1	1.320-1	1.254-1	5	108	1.543-1	1.480-1	

TABLE XIII: Comparison of effective collision strengths  $\Upsilon_{ij}$  (written in form  $a \pm b$  implying  $a \times 10^{\pm b}$ ) of Si IX between present results and those used by the Chianti code. The data at three temperatures of 0.5, 1.0 and 6.0 MK, is listed for some transitions. For each transition, the first row represents present results and the second row represents data included in the Chianti database.

$i$	$j$	$\Upsilon$			$i$	$j$	$\Upsilon$		
		0.5	1.0	6.0			0.1	1.0	6.0
1	2	8.359-2	7.295-2	3.641-2	2	3	2.485-1	2.615-1	1.810-1
		2.433-1	1.755-1	1.289-1			6.984-1	4.981-1	3.428-1
1	3	6.440-2	7.631-2	6.087-2	2	4	1.343-1	1.163-1	5.587-2
		1.761-1	1.242-1	8.295-2			1.773-1	1.515-1	1.275-1
1	4	4.305-2	3.728-2	1.791-2	2	5	1.862-2	1.588-2	7.105-3
		5.912-2	5.051-2	4.236-2			2.285-2	1.969-2	1.836-2
1	6	1.174-2	1.055-2	5.665-3	2	6	3.502-2	3.151-2	1.712-2
		1.260-2	1.142-2	6.208-3			3.685-2	3.360-2	1.862-2
1	9	3.788-1	4.022-1	5.292-1	2	14	7.327-1	7.758-1	1.022+0
		3.406-1	3.790-1	5.342-1			6.820-1	7.417-1	1.025+0
1	11	2.869-1	3.045-1	4.016-1	2	25	1.185-2	1.053-2	6.105-3
		2.790-1	3.066-1	4.271-1			1.116-2	9.967-3	6.019-3
1	14	2.392-1	2.532-1	3.335-1	2	38	1.846-2	1.677-2	1.262-2
		2.246-1	2.439-1	3.359-1			1.891-2	1.716-2	1.235-2
1	22	4.460-3	5.476-3	1.342-2	2	42	7.039-2	7.553-2	1.169-1
		2.885-3	3.930-3	1.012-2			6.999-2	7.618-2	1.173-1
1	36	5.298-4	4.717-4	2.814-4	2	43	3.165-1	3.559-1	6.192-1
		5.801-4	4.997-4	2.373-4			3.011-1	3.457-1	6.061-1
1	39	6.589-3	6.595-3	7.524-3	2	47	4.210-2	4.719-2	8.108-2
		6.580-3	6.550-3	6.831-3			3.879-2	4.431-2	7.669-2
1	42	1.493-1	1.686-1	2.959-1	3	6	5.764-2	5.189-2	2.836-2
		1.408-1	1.627-1	2.893-1			6.072-2	5.542-2	3.094-2
1	45	1.489-3	1.232-3	4.915-4	3	15	1.342-2	1.204-2	6.503-3
		1.840-3	1.536-3	6.125-4			1.482-2	1.347-2	7.455-3
1	47	8.640-4	7.417-4	3.407-4	3	28	3.531-2	3.376-2	3.155-2
		9.661-4	8.254-4	3.761-4			3.250-2	3.070-2	2.513-2
1	52	3.854-3	3.249-3	1.395-3	3	44	5.225-1	5.823-1	9.918-1
		5.177-3	4.367-3	1.855-3			5.032-1	5.717-1	9.791-1

TABLE XIV: Comparison of effective collision strength  $\Upsilon_{ij}$  for some excitations of Si X. Same as Table 13

$\Upsilon$					$\Upsilon$				
i	j	0.5	1.0	6.0	i	j	0.1	1.0	6.0
1	2	1.899-1	1.966-1	1.400-1	1	122	2.075-4	2.221-4	3.524-4
		7.373-1	4.944-1	1.661-1			3.660-4	4.046-4	6.604-4
1	4	2.130-2	1.936-2	1.074-2	2	5	5.928-2	5.399-2	3.054-2
		3.578-2	2.788-2	1.466-2			1.011-1	7.918-2	4.192-2
1	6	2.356-2	2.140-2	1.191-2	2	7	1.340-1	1.378-1	1.605-1
		4.998-2	3.643-2	1.737-2			1.577-1	1.382-1	1.013-1
1	7	6.756-1	7.173-1	9.409-1	2	8	3.630-1	3.838-1	4.996-1
		5.694-1	5.560-1	4.374-1			2.984-1	3.073-1	2.910-1
1	8	3.874-1	4.101-1	5.364-1	2	10	1.858+0	1.966+0	2.576+0
		3.336-1	3.401-1	2.993-1			1.637+0	1.650+0	1.481+0
1	12	3.932-3	4.216-3	5.811-3	2	15	8.334-3	8.302-3	8.835-3
		6.771-3	6.708-3	6.038-3			1.403-2	1.386-2	1.206-2
1	19	1.872-1	2.043-1	3.270-1	2	20	3.661-1	3.944-1	6.076-1
		1.897-1	2.169-1	3.811-1			3.668-1	4.109-1	7.000-1
1	20	3.363-2	3.017-2	1.963-2	2	25	2.093-1	2.150-1	2.382-1
		3.131-2	2.647-2	1.543-2			1.980-1	2.041-1	2.215-1
1	24	1.080-1	1.110-1	1.232-1	2	37	3.509-2	4.383-2	1.117-1
		1.022-1	1.054-1	1.146-1			4.480-2	6.035-2	1.575-1
1	36	1.838-2	2.309-2	5.965-2	2	57	1.781-2	1.956-2	2.903-2
		2.347-2	3.182-2	8.385-2			1.874-2	2.156-2	3.283-2
1	47	1.952-2	2.145-2	3.175-2	2	99	5.955-4	6.185-4	8.743-4
		1.836-2	2.114-2	3.244-2			6.689-4	6.835-4	9.166-4
1	67	1.212-2	1.301-2	1.824-2	2	108	1.869-4	2.052-4	3.744-4
		9.235-3	1.020-2	1.492-2			5.484-4	6.194-4	1.074-3
1	89	1.738-4	1.512-4	7.663-5	2	121	1.598-3	1.743-3	2.887-3
		3.926-4	4.963-4	1.186-3			3.016-3	3.394-3	5.676-3
1	113	2.139-4	2.196-4	2.605-4	2	125	8.118-4	7.205-4	3.652-4
		1.765-4	1.779-4	2.065-4			1.622-4	1.515-4	1.424-4

TABLE XV: Comparison of effective collision strength  $\Upsilon_{ij}$  for some excitations of Si XI. Same as in Table 13

$\Upsilon$					$\Upsilon$				
i	j	0.5	1.0	6.0	i	j	0.1	1.0	6.0
1	5	1.103+0	1.140+0	1.493+0	1	45	5.110-4	5.471-4	8.120-4
		1.073+0	1.134+0	1.458+0			2.225-4	2.344-4	3.140-4
1	12	5.331-2	5.378-2	6.001-2	1	46	3.189-3	3.426-3	5.611-3
		5.717-2	5.847-2	6.454-2			5.589-3	5.897-3	8.151-3
1	13	2.371-2	2.799-2	6.662-2	2	3	5.363-2	4.938-2	2.486-2
		2.390-2	2.734-2	5.449-2			1.677-1	1.203-1	4.522-2
1	17	5.270-3	4.827-3	2.283-3	2	5	1.187-2	1.091-2	5.351-3
		5.563-3	4.973-3	2.632-3			2.091-2	1.615-2	6.299-3
1	18	8.802-3	8.062-3	3.813-3	2	7	5.473-1	5.658-1	7.416-1
		9.285-3	8.304-3	4.399-3			5.484-1	5.795-1	7.403-1
1	19	1.229-2	1.126-2	5.327-3	2	14	3.507-2	3.515-2	3.767-2
		1.301-2	1.163-2	6.159-3			3.172-2	3.221-2	3.459-2
1	20	6.490-2	6.889-2	1.026-1	2	21	2.329-2	2.351-2	2.635-2
		6.873-2	7.350-2	1.035-1			2.535-2	2.592-2	2.876-2
1	24	7.324-4	8.630-4	2.083-3	2	33	1.802-2	1.870-2	2.513-2
		3.139-3	3.460-3	5.849-3			1.711-2	1.785-2	2.286-2
1	28	4.280-4	3.950-4	2.026-4	3	8	6.925-1	7.149-1	9.307-1
		4.157-4	3.776-4	2.127-4			6.963-1	7.350-1	9.310-1
1	32	1.014-4	9.356-5	4.843-5	3	15	1.065-1	1.065-1	1.124-1
		1.074-4	9.869-5	6.769-5			8.458-2	8.529-2	8.917-2
1	36	4.234-4	3.861-4	1.736-4	3	24	1.592-3	1.489-3	9.132-4
		3.382-4	3.011-4	1.568-4			1.858-3	1.710-3	1.168-3
1	40	1.279-4	1.160-4	4.851-5	3	44	3.091-4	2.861-4	1.566-4
		1.393-4	1.218-4	5.895-5			3.700-4	3.343-4	1.993-4

## EXPLANATION OF TABLES

<b>TALBE I.</b>	Energy levels (in <i>Ryd</i> ) of Si IX ion.
	Index                      A number assigned to each level
	Configuration            The configuration
	Expt.                      The data is from NIST website at <a href="http://physics.nist.gov/cgi-bin/AtData/main_asd">http://physics.nist.gov/cgi-bin/AtData/main_asd</a>
	FAC                        Data from FAC code
	CIV3                      The work of Aggarwal [11]
	OTC99                    The work of Orloski et al. [13]
	Chianti                   The work of Bhatia & Doschek [12]
<b>TABLE II.</b>	Energy levels (in <i>Ryd</i> ) of Si X ion.
	Index                      A number assigned to each level
	Configuration            The configuration
	FAC                        Calculation from FAC code
	CLT00                    The work of Cavalcanti et al. [19]
	Chianti                   The theoretical data is from literatures [15, 16, 17, 18]
<b>TALBE III.</b>	Energy levels (in <i>Ryd</i> ) of Si XI ion.
	Index                      A number assigned to each level
	Configuration            The configuration
	FAC                        Present 350 level calculation from FAC code
	HFR                       The work of Coutinho & Trigueiros [22]
	Chianti                   The data from Sampson et al. [20] and Zhang & Sampson [21].
<b>TALBE VII–IX.</b>	Collision strengths $\Omega$ for Si IX, Si X and Si XI at ten scattered electron energies (in eV) of 10, 50, 100, 200, 400, 600, 800, 1000, 1500 and 2000, respectively.
	The data is written in the form $a \pm b$ implying $a \times 10^b$ .
<b>TALBE X–XII.</b>	Effective collision strengths $\Upsilon$ for Si IX, Si X and Si XI at seven tempera- tures (MK): 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 along with weighted oscillator strengths $gf$ and radiative rates $A$ , respectively.
	The data is written in the form $a \pm b$ implying $a \times 10^b$ .

TABLE I: Energy levels (in *Ryd*) of Si IX ion.

Index	Configuration	LSJ	Expt.	FAC	CIV3	OTC99	Chianti
1	$2s^2 2p^2$	$^3P_0$		0.0000	0.0000		0.000
2	$2s^2 2p^2$	$^3P_1$	0.0232	0.0226	0.0226		0.023
3	$2s^2 2p^2$	$^3P_2$	0.0585	0.0570	0.0575		0.058
4	$2s^2 2p^2$	$^1D_2$	0.4823	0.5081	0.5110		0.506
5	$2s^2 2p^2$	$^1S_0$	0.9823	0.9949	1.0500		0.948
6	$2s 2p^3$	$^5S_2$	1.3690	1.3025	1.3416		1.261
7	$2s 2p^3$	$^3D_3$	2.6631	2.6893	2.6867	2.6621	2.673
8	$2s 2p^3$	$^3D_2$	2.6636	2.6898	2.6871	2.6627	2.670
9	$2s 2p^3$	$^3D_1$	2.6649	2.6909	2.6881	2.6602	2.671
10	$2s 2p^3$	$^3P_2$	3.1359	3.1668	3.1809	3.1354	3.136
11	$2s 2p^3$	$^3P_1$	3.1349	3.1668	3.1817	3.1350	3.137
12	$2s 2p^3$	$^3P_0$	3.1354	3.1678	3.1805	3.1351	3.139
13	$2s 2p^3$	$^1D_2$	4.0132	4.1204	4.0740	4.0133	4.144
14	$2s 2p^3$	$^3S_1$	4.0728	4.1651	4.1190	4.0720	4.205
15	$2s 2p^3$	$^1P_1$	4.4903	4.6007	4.5760	4.4911	4.610
16	$2p^4$	$^3P_2$	6.1488	6.2336	6.2545	6.1479	6.262
17	$2p^4$	$^3P_1$	6.1903	6.2752	6.2950	6.1896	6.303
18	$2p^4$	$^3P_0$	6.2065	6.2887	6.3111	6.2047	6.320
19	$2p^4$	$^1D_2$	6.5566	6.6892	6.6769	6.5570	6.745
20	$2p^4$	$^1S_0$	7.4696	7.6367	7.6551	7.4702	7.685
21	$2s^2 2p 3s$	$^3P_0$		14.7296	14.8425		14.991
22	$2s^2 2p 3s$	$^3P_1$	14.7933	14.7453	14.8574	14.7925	15.006
23	$2s^2 2p 3s$	$^3P_2$	14.8400	14.7911	14.9004	14.8391	15.051
24	$2s^2 2p 3s$	$^1P_1$	14.9525	14.9307	15.0370	14.9521	15.170
25	$2s^2 2p 3p$	$^1P_1$		15.4136	15.4789		15.662
26	$2s^2 2p 3p$	$^3D_1$		15.4788	15.5482		15.715
27	$2s^2 2p 3p$	$^3D_2$		15.4937	15.5636		15.727
28	$2s^2 2p 3p$	$^3D_3$		15.5333	15.6014		15.767
29	$2s^2 2p 3p$	$^3S_1$		15.6022	15.6734		15.838
30	$2s^2 2p 3p$	$^3P_0$		15.6550	15.7213		15.964
31	$2s^2 2p 3p$	$^3P_1$		15.6751	15.7405		15.982
32	$2s^2 2p 3p$	$^3P_2$		15.6944	15.7586		16.003
33	$2s^2 2p 3p$	$^1D_2$		15.9415	15.9934		16.158
34	$2s 2p^2(^2S)3s$	$^3S_1$		16.1831		16.2622	
35	$2s 2p^2(^2D)3s$	$^1D_2$		16.2017		16.2818	
36	$2s^2 2p 3p$	$^1S_0$		16.2121	16.2563		16.407
37	$2s 2p^2(^4P)3s$	$^5P_3$		16.2309		16.3109	
38	$2s^2 2p 3d$	$^3F_2$		16.2850	16.3183	16.3057	16.500
39	$2s^2 2p 3d$	$^3F_3$		16.3207	16.3505		16.529
40	$2s^2 2p 3d$	$^1D_2$	16.3486	16.3352	16.3571	16.3484	16.551
41	$2s^2 2p 3d$	$^3F_4$		16.3492	16.3807		16.561
42	$2s^2 2p 3d$	$^3D_1$	16.4772	16.4629	16.5016	16.4773	16.692
43	$2s^2 2p 3d$	$^3D_2$	16.4852	16.4748	16.5075	16.4848	16.698
44	$2s^2 2p 3d$	$^3D_3$	16.5070	16.4939	16.5282	16.5071	16.720
45	$2s^2 2p 3d$	$^3P_2$	16.5455	16.5290	16.5595	16.5455	16.752
46	$2s^2 2p 3d$	$^3P_1$	16.5569	16.5404	16.5692	16.5566	16.761
47	$2s^2 2p 3d$	$^3P_0$	16.5635	16.5470	16.5746	16.5630	16.766
48	$2s 2p^2(^2S)3s$	$^1S_0$		16.6427			
49	$2s 2p^2(^2D)3s$	$^3D_1$		16.6575			
50	$2s 2p^2(^4P)3s$	$^3P_2$		16.6888			
51	$2s^2 2p 3d$	$^1P_1$	16.7542	16.7481	16.7985	16.7529	16.987
52	$2s^2 2p 3d$	$^1F_3$	16.7471	16.7602	16.8024	16.7468	16.998
53	$2s 2p^2(^4P)3p$	$^3S_1$	16.9363	16.8788		16.9364	
54	$2s 2p^2(^2S)3p$	$^3P_0$		16.9209			
55	$2s 2p^2(^2S)3p$	$^1P_1$		16.9263			
56	$2s 2p^2(^2D)3p$	$^1D_2$		16.9374			
57	$2s 2p^2(^2D)3p$	$^1F_3$		16.9550			
58	$2s 2p^2(^4P)3p$	$^5D_4$		16.9804			
59	$2s 2p^2(^2D)3p$	$^1P_1$		17.0150			

Table I—*continued* ...

Index	Configuration	LSJ	Expt.	FAC	CIV3	OTC99	Chianti
60	$2s2p^2(^4P)3p$	$^5P_2$		17.0251			
61	$2s2p^2(^4P)3p$	$^5D_3$		17.0429			
62	$2s2p^2(^2S)3p$	$^5P_1$		17.2390			
63	$2s2p^2(^4P)3p$	$^3D_2$	17.2788	17.2536		17.2784	
64	$2s2p^2(^4P)3p$	$^3D_3$	17.3049	17.2786		17.3050	
65	$2s2p^2(^4P)3p$	$^5P_2$		17.3325			
66	$2s2p^2(^2P)3p$	$^3P_0$		17.3858			
	available on request						
557	$2s2p^2(^4P)4f$	$^3G_4$		24.4150			
558	$2s2p^2(^4P)4f$	$^3G_3$		24.4166			
559	$2s2p^2(^4P)4f$	$^5D_4$		24.4195			
560	$2s2p^2(^4P)4f$	$^3G_3$		24.4264			



TABLE II:

Index	Configuration	LSJ	Expt.	FAC	CLT00	Chianti
1	$2s^2 2p$	$^2P_{1/2}$		0.0000		0.0000
2	$2s^2 2p$	$^2P_{3/2}$	0.0637	0.0623	0.0636	0.0637
3	$2s 2p^2$	$^4P_{1/2}$	1.4672	1.4335	1.4756	1.4672
4	$2s 2p^2$	$^4P_{3/2}$	1.4898	1.4567	1.4977	1.4898
5	$2s 2p^2$	$^4P_{5/2}$	1.5224	1.4880	1.5304	1.5224
6	$2s 2p^2$	$^2D_{5/2}$	2.6231	2.6622	2.6230	2.6231
7	$2s 2p^2$	$^2D_{3/2}$	2.6234	2.6620	2.6231	2.6234
8	$2s 2p^2$	$^2S_{1/2}$	3.3505	3.4029	3.3503	3.3505
9	$2s 2p^2$	$^2P_{1/2}$	3.5543	3.6325	3.5545	3.5543
10	$2s 2p^2$	$^2P_{3/2}$	3.5907	3.6687	3.5909	3.5907
11	$2p^3$	$^4S_{3/2}$	4.6414	4.6274	4.6488	4.6414
12	$2p^3$	$^2D_{3/2}$	5.2437	5.2973	5.2438	5.2437
13	$2p^3$	$^2D_{5/2}$	5.2439	5.2984	5.2442	5.2439
14	$2p^3$	$^2P_{1/2}$	5.8937	5.9806	5.8937	5.8937
15	$2p^3$	$^2P_{3/2}$	5.8994	5.9832	5.8996	5.8995
16	$2s^2 3s$	$^2S_{1/2}$		16.5368	16.6033	16.4970
17	$2s^2 3p$	$^2P_{1/2}$		17.2881	17.6598	17.2366
18	$2s^2 3p$	$^2P_{3/2}$		17.3046	17.6792	17.2548
19	$2s^2 3d$	$^2D_{3/2}$	18.0363	17.9972	18.0364	17.9443
20	$2s^2 3d$	$^2D_{5/2}$	18.0406	18.0014	18.0406	17.9493
21	$2s 2p(^3P)3s$	$^4P_{1/2}$	18.1600	18.1088	18.1683	18.0608
22	$2s 2p(^3P)3s$	$^4P_{3/2}$	18.1810	18.1293	18.1890	18.0818
23	$2s 2p(^3P)3s$	$^4P_{5/2}$	18.2215	18.1675	18.2296	18.1209
24	$2s 2p(^3P)3s$	$^2P_{1/2}$	18.5084	18.5012	18.5086	18.4184
25	$2s 2p(^3P)3s$	$^2P_{3/2}$	18.5521	18.5431	18.5518	18.4615
26	$2s 2p(^3P)3p$	$^4D_{1/2}$		18.7772		18.7209
27	$2s 2p(^3P)3p$	$^4D_{3/2}$		18.7954		18.7405
28	$2s 2p(^3P)3p$	$^2P_{1/2}$	18.8139	18.8146	18.8140	18.7593
29	$2s 2p(^3P)3p$	$^2P_{3/2}$	18.8336	18.8238	18.8442	18.7683
30	$2s 2p(^3P)3p$	$^4D_{5/2}$		18.8269		18.7769
31	$2s 2p(^3P)3p$	$^4D_{7/2}$		18.8607		18.8121
32	$2s 2p(^3P)3p$	$^4S_{3/2}$		18.9586		18.9056
33	$2s 2p(^3P)3p$	$^4P_{1/2}$		19.0822		18.9858
34	$2s 2p(^3P)3p$	$^4P_{3/2}$		19.0993		19.0046
35	$2s 2p(^3P)3p$	$^4P_{5/2}$		19.1179		19.0227
36	$2s 2p(^3P)3p$	$^2D_{3/2}$	19.1890	19.1919	19.1892	19.1028
37	$2s 2p(^3P)3p$	$^2D_{5/2}$	19.2301	19.2327	19.2302	19.1437
38	$2s 2p(^3P)3d$	$^4F_{3/2}$		19.3973		19.3414
39	$2s 2p(^3P)3d$	$^4F_{5/2}$		19.4121		19.3544
40	$2s 2p(^3P)3d$	$^4F_{7/2}$		19.4318		19.3738
41	$2s 2p(^3P)3p$	$^2S_{1/2}$	19.4337	19.4463	19.4335	19.3548
42	$2s 2p(^3P)3d$	$^4F_{9/2}$		19.4548		19.4014
43	$2s 2p(^3P)3d$	$^4D_{1/2}$	19.6004	19.5722		19.5081
44	$2s 2p(^3P)3d$	$^4D_{3/2}$		19.5757	19.6090	19.5096
45	$2s 2p(^3P)3d$	$^4D_{5/2}$	19.6046	19.5820	19.6138	19.5130
46	$2s 2p(^3P)3d$	$^4D_{7/2}$	19.6271	19.5997	19.6353	19.5349
47	$2s 2p(^3P)3d$	$^2D_{3/2}$	19.6260	19.6198	19.6260	19.5313
48	$2s 2p(^3P)3d$	$^2D_{5/2}$	19.6331	19.6240	19.6332	19.5390
49	$2s 2p(^3P)3d$	$^4P_{5/2}$	19.6917	19.6568	19.6999	19.5923
available on request						
298	$2s 2p(^3P)5p$	$^2D_{3/2}$		28.3518		
299	$2s 2p(^3P)5p$	$^2D_{5/2}$		28.3536		
300	$2s 2p(^3P)5p$	$^2P_{1/2}$		28.3581		
301	$2s 2p(^3P)5p$	$^4S_{3/2}$		28.3606		
302	$2s 2p(^3P)5p$	$^4P_{1/2}$		28.3967		
303	$2s 2p(^3P)5d$	$^2F_{7/2}$		28.4662	28.3994	
304	$2s 2p(^3P)5d$	$^2F_{5/2}$		28.4663	28.4308	
305	$2s 2p(^3P)5d$	$^2D_{3/2}$		28.4665	28.3992	
306	$2s 2p(^3P)5d$	$^4P_{5/2}$		28.4677		

Table II—*continued* ...

Index	Configuration	LSJ	Expt.	FAC	CLT00	Chianti
307	$2s2p(^3P)5d$	$^2P_{1/2}$		28.4976		
308	$2s2p(^3P)5d$	$^4P_{3/2}$		28.4983		
309	$2s2p(^3P)5g$	$^2G_{7/2}$		28.5209		
310	$2s2p(^3P)5g$	$^4F_{9/2}$		28.5211		
311	$2s2p(^3P)5f$	$^2F_{5/2}$		28.5242		
312	$2s2p(^3P)5f$	$^4D_{7/2}$		28.5246		
313	$2s2p(^3P)5g$	$^2H_{9/2}$		28.5328		
314	$2s2p(^3P)5g$	$^2H_{11/2}$		28.5330		
315	$2s2p(^3P)5f$	$^4D_{5/2}$		28.5371		
316	$2s2p(^3P)5g$	$^4F_{7/2}$		28.5373		
317	$2s2p(^3P)5f$	$^2G_{7/2}$		28.5443		
318	$2s2p(^3P)5f$	$^2G_{9/2}$		28.5446		
319	$2s2p(^3P)5f$	$^2D_{3/2}$		28.5578		
320	$2s2p(^3P)5f$	$^2D_{5/2}$		28.5580		

TABLE III:

Index	Configuration	LSJ	Expt.	FAC	CT01	Chianti
1	$2s^2$	$^1S_0$		0.000000	0.000000	0.000000
2	$2s2p$	$^3P_0$	1.547354	1.544777	1.547362	1.556960
3	$2s2p$	$^3P_1$	1.568696	1.565661	1.568859	1.578420
4	$2s2p$	$^3P_2$	1.615845	1.611971	1.615744	1.625680
5	$2s2p$	$^1P_1$	3.004365	3.050184	3.004353	3.131050
6	$2p^2$	$^3P_0$	4.043030	4.031292	4.043251	4.069800
7	$2p^2$	$^3P_1$	4.068764	4.060359	4.068830	4.095150
8	$2p^2$	$^3P_2$	4.109507	4.099710	4.109646	4.136090
9	$2p^2$	$^1D_2$	4.512617	4.540432	4.512730	4.614360
10	$2p^2$	$^1S_0$	5.547427	5.624651	5.547728	5.689970
11	$2s3s$	$^3S_1$	20.145382	20.113743	20.146660	19.776400
12	$2s3s$	$^1S_0$	20.428877	20.417677	20.429729	20.148800
13	$2s3p$	$^1P_1$	20.822817	20.825602	20.826143	20.658401
14	$2s3p$	$^3P_0$	20.824370	20.850800	20.850365	20.677999
15	$2s3p$	$^3P_1$	20.824370	20.858654	20.860752	20.677999
16	$2s3p$	$^3P_2$	20.824370	20.868895	20.866348	20.697599
17	$2s3d$	$^3D_1$		21.243521	21.244827	21.207199
18	$2s3d$	$^3D_2$	21.251204	21.245701	21.253338	21.226801
19	$2s3d$	$^3D_3$	21.255487	21.249430	21.254696	21.226801
20	$2s3d$	$^1D_2$	21.517658	21.541889	21.515211	21.599201
21	$2p3s$	$^3P_0$		22.100626	22.088411	22.030401
22	$2p3s$	$^3P_1$		22.120941	22.114548	22.069599
23	$2p3s$	$^3P_2$	22.145796	22.170929	22.158224	22.128399
24	$2p3s$	$^1P_1$	22.515768	22.456436	22.516539	22.481199
25	$2p3p$	$^1S_0$		22.543678	22.533634	22.598801
26	$2p3p$	$^1P_1$		22.622646	22.600367	22.696800
27	$2p3p$	$^1D_2$		22.639996	22.619520	22.716400
28	$2p3p$	$^3D_3$	22.666128	22.687033	22.666525	22.794800
29	$2p3p$	$^3S_1$	22.785503	22.804148	22.785364	22.931999
30	$2p3p$	$^3P_0$	22.847015	22.902258	22.846100	23.010399
31	$2p3p$	$^3P_1$	22.873987	22.922987	22.874140	23.049601
32	$2p3p$	$^3P_2$	22.894491	22.946426	22.895081	23.069201
33	$2p3d$	$^3F_2$		22.973572	22.944773	23.147600
34	$2p3d$	$^1F_3$		23.014633	22.981279	23.206400
available on request						
323	$2p7h$	$^3I_5$		34.357094		
324	$2p7i$	$^3H_5$		34.357132		
325	$2p7i$	$^3J_6$		34.357189		
326	$2p7g$	$^3G_4$		34.357510		
327	$2p7g$	$^3H_5$		34.357689		
328	$2p7i$	$^3I_7$		34.357918		
329	$2p7i$	$^3J_8$		34.357975		
330	$2p7h$	$^3H_6$		34.358189		
331	$2p7h$	$^3I_7$		34.358253		
332	$2p7i$	$^3H_4$		34.358383		
333	$2p7i$	$^3J_5$		34.358437		
334	$2p7f$	$^3G_5$		34.358879		
335	$2p7f$	$^3G_3$		34.359028		
336	$2p7h$	$^3G_3$		34.359108		
337	$2p7h$	$^3H_4$		34.359184		
338	$2p7g$	$^3F_3$		34.359249		
339	$2p7g$	$^3G_4$		34.359264		
340	$2p7f$	$^3D_2$		34.360397		
341	$2p7g$	$^3H_6$		34.360783		
342	$2p7g$	$^3G_5$		34.360950		
343	$2p7g$	$^3F_2$		34.362793		
344	$2p7g$	$^3H_3$		34.362942		
345	$2p7f$	$^3G_4$		34.363071		
346	$2p7f$	$^3D_1$		34.364277		

Table III–*continued* ...

Index	Configuration	LSJ	Expt.	FAC	CT01	Chianti
347	$2p7d$	$^3F_3$		34.364918		
348	$2p7p$	$^3P_0$		34.366123		
349	$2p7f$	$^3F_2$		34.367489		
350	$2p7d$	$^3D_1$		34.367958		

TABLE VII:

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
1	2	9.040-02	7.805-02	6.377-02	4.670-02	2.733-02	1.793-02	1.274-02	9.500-03	5.314-03	3.353-03
1	3	4.495-01	2.123-01	9.070-02	7.488-02	6.186-02	3.720-02	3.540-02	3.593-02	3.053-02	2.962-02
1	4	3.933-02	3.752-02	3.260-02	2.324-02	1.267-02	8.160-03	5.565-03	3.977-03	2.164-03	1.345-03
1	5	5.625-03	5.129-03	4.243-03	2.870-03	1.423-03	8.418-04	5.267-04	3.455-04	1.633-04	8.897-05
1	6	1.274-02	1.134-02	9.723-03	7.414-03	4.620-03	3.097-03	2.234-03	1.683-03	9.516-04	6.050-04
1	7	4.332-05	3.274-05	2.340-05	3.693-05	8.214-05	3.605-05	4.109-05	4.763-05	3.705-05	3.546-05
1	8	1.060-02	9.376-03	7.984-03	6.061-03	3.767-03	2.522-03	1.819-03	1.372-03	7.751-04	4.927-04
1	9	3.492-01	3.815-01	4.157-01	4.652-01	5.344-01	5.842-01	6.222-01	6.528-01	7.101-01	7.532-01
1	10	2.621-03	2.290-03	1.928-03	1.455-03	8.993-04	5.972-04	4.291-04	3.226-04	1.805-04	1.138-04
1	11	2.566-01	2.860-01	3.147-01	3.520-01	4.045-01	4.433-01	4.730-01	4.970-01	5.422-01	5.762-01
1	12	1.576-03	1.378-03	1.160-03	8.740-04	5.385-04	3.568-04	2.559-04	1.921-04	1.072-04	6.740-05
1	13	6.334-03	5.508-03	4.635-03	3.525-03	2.203-03	1.475-03	1.067-03	8.064-04	4.557-04	2.897-04
1	14	2.139-01	2.378-01	2.612-01	2.912-01	3.347-01	3.673-01	3.931-01	4.141-01	4.535-01	4.838-01
1	15	2.367-03	2.026-03	1.685-03	1.278-03	8.017-04	5.371-04	3.925-04	3.011-04	1.774-04	1.202-04
1	16	1.808-03	1.865-03	1.961-03	2.120-03	2.848-03	3.401-03	2.923-03	2.600-03	2.827-03	2.903-03
1	17	9.217-05	8.519-05	7.205-05	4.936-05	2.521-05	1.520-05	9.707-06	6.486-06	3.087-06	1.687-06
1	18	7.107-04	6.728-04	6.340-04	5.944-04	5.446-04	5.185-04	5.047-04	4.957-04	4.824-04	4.762-04
1	19	3.261-04	2.968-04	2.487-04	1.704-04	8.758-05	5.275-05	3.378-05	2.267-05	1.080-05	5.928-06
1	20	5.783-05	5.198-05	4.350-05	3.061-05	1.705-05	1.122-05	8.125-06	6.328-06	4.451-06	3.809-06
1	21	7.476-04	7.428-04	6.705-04	4.863-04	2.821-04	1.867-04	1.299-04	9.416-05	5.144-05	3.145-05
1	22	3.337-03	4.498-03	5.812-03	8.247-03	1.262-02	1.629-02	1.956-02	2.236-02	2.788-02	3.230-02
1	23	7.302-04	7.318-04	6.623-04	4.771-04	2.738-04	1.806-04	1.250-04	9.015-05	4.905-05	2.986-05
1	24	8.013-04	7.976-04	7.353-04	5.772-04	4.143-04	3.508-04	3.228-04	3.121-04	3.199-04	3.409-04
1	25	5.156-03	4.363-03	3.490-03	2.459-03	1.406-03	8.944-04	6.258-04	4.614-04	2.472-04	1.498-04
1	26	3.500-03	2.965-03	2.357-03	1.624-03	8.924-04	5.502-04	3.748-04	2.700-04	1.389-04	8.148-05
1	27	8.048-03	7.763-03	7.764-03	8.454-03	9.592-03	1.044-02	1.117-02	1.193-02	1.349-02	1.390-02
1	28	2.383-03	2.061-03	1.661-03	1.145-03	6.310-04	3.947-04	2.707-04	1.957-04	1.019-04	6.024-05
1	29	2.013-03	1.691-03	1.330-03	9.024-04	4.787-04	2.841-04	1.876-04	1.316-04	6.418-05	3.611-05
1	30	3.718-02	3.586-02	3.559-02	3.708-02	3.865-02	3.918-02	3.959-02	3.984-02	4.006-02	4.016-02
1	31	4.873-03	4.071-03	3.250-03	2.340-03	1.384-03	8.974-04	6.402-04	4.802-04	2.641-04	1.636-04
1	32	2.959-03	2.747-03	2.555-03	2.453-03	2.451-03	2.523-03	2.624-03	2.752-03	3.046-03	3.120-03
1	33	3.133-03	2.706-03	2.180-03	1.502-03	8.250-04	5.126-04	3.495-04	2.516-04	1.308-04	7.765-05
1	34	3.495-03	2.940-03	2.323-03	1.604-03	9.011-04	5.748-04	4.056-04	3.023-04	1.666-04	1.033-04
1	35	4.164-06	3.807-06	3.217-06	2.282-06	1.321-06	8.898-07	6.507-07	5.067-07	3.388-07	2.591-07
1	36	5.871-04	5.077-04	4.213-04	3.240-04	2.282-04	1.842-04	1.631-04	1.511-04	1.366-04	1.305-04
1	37	2.189-05	2.031-05	1.720-05	1.189-05	6.528-06	4.183-06	2.867-06	2.061-06	1.098-06	6.558-07
1	38	7.513-03	7.231-03	6.097-03	3.901-03	1.839-03	1.101-03	6.994-04	4.680-04	2.387-04	1.399-04
1	39	5.367-03	6.102-03	6.499-03	6.728-03	7.308-03	7.818-03	8.217-03	8.737-03	1.003-02	1.032-02
1	40	5.322-03	5.327-03	4.639-03	3.049-03	1.489-03	9.220-04	5.956-04	4.028-04	2.097-04	1.243-04
1	41	2.934-03	2.773-03	2.319-03	1.494-03	7.170-04	4.305-04	2.762-04	1.872-04	9.567-05	5.595-05
1	42	1.329-01	1.528-01	1.772-01	2.205-01	2.898-01	3.444-01	3.906-01	4.306-01	5.107-01	5.727-01
1	43	7.865-03	7.750-03	6.695-03	4.405-03	2.163-03	1.335-03	8.649-04	5.875-04	3.054-04	1.808-04
1	44	3.365-03	3.474-03	3.314-03	2.886-03	2.580-03	2.548-03	2.567-03	2.659-03	2.965-03	3.022-03
1	45	1.207-03	1.205-03	1.014-03	6.049-04	2.436-04	1.347-04	7.641-05	4.484-05	2.090-05	1.193-05
1	46	1.002-02	1.131-02	1.270-02	1.506-02	1.901-02	2.225-02	2.502-02	2.743-02	3.231-02	3.609-02
1	47	7.397-04	7.381-04	6.473-04	4.371-04	2.234-04	1.414-04	9.360-05	6.483-05	3.451-05	2.078-05
available on request											
20	298	3.374-08	4.069-08	4.920-08	6.386-08	8.450-08	9.963-08	1.101-07	1.183-07	1.338-07	1.449-07
20	300	3.965-06	3.357-06	2.807-06	2.091-06	1.270-06	8.506-07	6.059-07	4.517-07	2.499-07	1.565-07
20	302	5.059-10	4.350-10	3.896-10	4.263-10	5.305-10	5.849-10	6.062-10	6.130-10	6.062-10	6.248-10
20	303	6.655-06	5.632-06	4.710-06	3.511-06	2.137-06	1.433-06	1.024-06	7.667-07	4.308-07	2.760-07
20	304	1.369-08	1.634-08	1.968-08	2.557-08	3.421-08	4.070-08	4.534-08	4.901-08	5.600-08	6.114-08
20	305	4.971-10	3.656-10	2.607-10	1.477-10	6.542-11	3.696-11	2.310-11	1.532-11	6.607-12	3.374-12
20	306	9.442-06	7.989-06	6.679-06	4.974-06	3.022-06	2.024-06	1.442-06	1.075-06	5.949-07	3.725-07
20	310	3.921-10	2.672-10	1.758-10	8.783-11	3.385-11	1.773-11	1.056-11	6.796-12	2.811-12	1.425-12
20	311	3.520-10	2.460-10	1.706-10	1.214-10	1.171-10	1.191-10	1.171-10	1.146-10	1.117-10	1.156-10
20	312	8.861-10	6.400-10	4.484-10	2.467-10	1.023-10	5.445-11	3.308-11	2.173-11	9.329-12	4.913-12
20	313	8.908-10	7.059-10	5.833-10	5.502-10	5.888-10	6.542-10	7.155-10	7.030-10	8.622-10	1.191-09
20	314	9.768-10	7.346-10	5.447-10	3.327-10	1.604-10	9.214-11	5.790-11	3.853-11	1.654-11	8.508-12

Table VII—continued ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
20	316	3.195-06	2.610-06	2.119-06	1.469-06	8.346-07	5.296-07	3.637-07	2.635-07	1.347-07	7.872-08
20	317	1.792-05	1.855-05	1.972-05	2.215-05	2.695-05	3.150-05	3.561-05	3.945-05	4.775-05	5.416-05
20	319	1.725-05	1.415-05	1.154-05	8.048-06	4.606-06	2.934-06	2.021-06	1.468-06	7.553-07	4.443-07
20	321	4.165-05	4.898-05	5.759-05	7.249-05	9.655-05	1.168-04	1.341-04	1.499-04	1.832-04	2.084-04
20	322	1.846-05	1.488-05	1.178-05	8.045-06	4.340-06	2.703-06	1.824-06	1.300-06	6.629-07	3.893-07
20	324	3.274-05	2.674-05	2.163-05	1.567-05	9.947-06	7.578-06	6.378-06	5.704-06	4.964-06	4.678-06
20	326	2.097-05	1.773-05	1.460-05	1.050-05	5.995-06	3.859-06	2.671-06	1.946-06	1.033-06	6.268-07
20	328	3.852-05	3.778-05	3.745-05	3.767-05	3.795-05	3.830-05	3.856-05	3.875-05	3.906-05	3.921-05
20	330	4.741-05	3.786-05	2.977-05	2.021-05	1.089-05	6.803-06	4.602-06	3.285-06	1.676-06	9.868-07
20	331	2.457-05	2.094-05	1.737-05	1.262-05	7.294-06	4.736-06	3.300-06	2.416-06	1.293-06	7.892-07
20	332	2.461-05	2.101-05	1.745-05	1.268-05	7.327-06	4.753-06	3.310-06	2.424-06	1.299-06	7.922-07
20	333	2.630-05	2.227-05	1.869-05	1.450-05	1.057-05	9.100-06	8.511-06	8.275-06	8.183-06	8.223-06
20	334	3.267-05	3.060-05	2.893-05	2.777-05	2.796-05	2.905-05	3.038-05	3.161-05	3.387-05	3.526-05
20	335	3.893-05	2.945-05	2.209-05	1.379-05	6.531-06	3.741-06	2.389-06	1.644-06	8.025-07	4.635-07
20	337	5.269-05	4.015-05	3.050-05	1.987-05	1.090-05	7.683-06	6.262-06	5.537-06	4.885-06	4.834-06
20	339	4.323-04	4.322-04	4.366-04	4.498-04	4.638-04	4.727-04	4.782-04	4.819-04	4.872-04	4.897-04
20	341	6.429-05	4.916-05	3.746-05	2.396-05	1.177-05	6.927-06	4.513-06	3.151-06	1.566-06	9.133-07
20	342	1.689-06	1.397-06	1.113-06	7.585-07	4.088-07	2.552-07	1.727-07	1.237-07	6.430-08	3.836-08
20	343	2.021-04	2.157-04	2.344-04	2.675-04	3.188-04	3.601-04	3.945-04	4.239-04	4.836-04	5.307-04
20	344	3.870-06	3.238-06	2.626-06	1.851-06	1.086-06	7.541-07	5.815-07	4.811-07	3.630-07	3.190-07
20	345	6.712-06	5.600-06	4.514-06	3.129-06	1.717-06	1.083-06	7.389-07	5.330-07	2.800-07	1.677-07
20	346	8.103-05	6.170-05	4.661-05	2.944-05	1.423-05	8.274-06	5.347-06	3.715-06	1.836-06	1.064-06
20	347	4.842-05	3.648-05	2.729-05	1.693-05	7.909-06	4.485-06	2.839-06	1.939-06	9.346-07	5.392-07
20	349	3.754-05	2.826-05	2.125-05	1.366-05	7.544-06	5.467-06	4.598-06	4.197-06	3.842-06	3.677-06
20	351	2.358-06	1.481-06	9.240-07	4.369-07	1.540-07	7.264-08	3.982-08	2.410-08	8.990-09	4.346-09
20	352	4.833-06	3.062-06	1.898-06	8.557-07	2.747-07	1.195-07	6.038-08	3.373-08	1.018-08	3.930-09
20	353	1.862-05	1.394-05	1.050-05	6.908-06	4.205-06	3.281-06	2.914-06	2.780-06	2.708-06	2.528-06
20	354	2.717-06	1.782-06	1.206-06	7.599-07	5.590-07	5.620-07	5.521-07	5.408-07	5.436-07	5.722-07
20	355	8.617-05	6.635-05	5.095-05	3.300-05	1.653-05	9.865-06	6.494-06	4.569-06	2.297-06	1.346-06
20	356	7.203-05	5.723-05	4.584-05	3.264-05	2.077-05	1.624-05	1.423-05	1.328-05	1.270-05	1.291-05
20	357	2.742-05	2.138-05	1.665-05	1.103-05	5.709-06	3.483-06	2.329-06	1.658-06	8.466-07	4.985-07
20	358	1.845-05	1.275-05	8.674-06	4.632-06	1.871-06	9.837-07	5.908-07	3.865-07	1.688-07	8.893-08
20	360	2.186-05	1.587-05	1.186-05	8.194-06	6.279-06	6.032-06	6.081-06	6.225-06	6.604-06	6.807-06
20	361	3.060-05	2.127-05	1.454-05	7.720-06	3.016-06	1.520-06	8.839-07	5.639-07	2.277-07	1.093-07
20	362	3.192-05	3.148-05	3.272-05	3.672-05	4.307-05	4.785-05	5.099-05	5.305-05	5.583-05	5.743-05
20	363	3.831-05	4.306-05	4.935-05	6.259-05	8.739-05	1.095-04	1.268-04	1.393-04	1.592-04	1.724-04
20	364	2.894-05	2.502-05	2.306-05	2.346-05	2.803-05	3.242-05	3.592-05	3.856-05	4.368-05	4.807-05
20	365	1.249-03	1.391-03	1.558-03	1.834-03	2.235-03	2.542-03	2.793-03	3.006-03	3.434-03	3.770-03
20	367	2.221-06	1.355-06	8.139-07	3.585-07	1.152-07	5.348-08	2.951-08	1.808-08	6.873-09	3.225-09
20	368	2.645-06	1.652-06	1.035-06	5.465-07	3.134-07	2.854-07	2.712-07	2.618-07	2.578-07	2.675-07
20	369	5.501-06	4.792-06	4.460-06	4.374-06	4.715-06	4.937-06	5.133-06	5.324-06	5.614-06	5.498-06
20	370	5.486-06	3.518-06	2.213-06	1.027-06	3.466-07	1.573-07	8.299-08	4.833-08	1.583-08	6.445-09
20	371	4.238-06	2.720-06	1.743-06	8.629-07	3.199-07	1.525-07	8.340-08	5.021-08	1.870-08	9.152-09
20	372	3.281-06	2.273-06	1.650-06	1.203-06	1.044-06	1.113-06	1.122-06	1.115-06	1.133-06	1.188-06
20	373	5.090-06	3.330-06	2.137-06	1.023-06	3.581-07	1.640-07	8.659-08	5.034-08	1.640-08	6.737-09
20	374	9.023-06	7.962-06	7.435-06	7.256-06	7.780-06	8.131-06	8.447-06	8.758-06	9.233-06	9.055-06
20	375	1.801-05	1.211-05	7.971-06	3.997-06	1.452-06	7.184-07	4.214-07	2.756-07	1.233-07	6.581-08
20	376	2.354-05	1.595-05	1.065-05	5.483-06	2.195-06	1.254-06	8.678-07	6.813-07	5.008-07	4.384-07
20	377	3.431-05	2.409-05	1.667-05	9.184-06	3.881-06	2.087-06	1.264-06	8.275-07	3.584-07	1.885-07
20	378	4.088-05	2.869-05	1.982-05	1.070-05	4.272-06	2.174-06	1.267-06	8.056-07	3.209-07	1.525-07
20	379	2.242-05	1.810-05	1.576-05	1.438-05	1.504-05	1.629-05	1.732-05	1.822-05	1.986-05	2.065-05
20	380	4.582-05	4.408-05	4.479-05	4.913-05	5.737-05	6.404-05	6.860-05	7.172-05	7.607-05	7.761-05
20	381	2.504-05	1.779-05	1.246-05	6.867-06	2.818-06	1.452-06	8.482-07	5.379-07	2.110-07	9.884-08
20	382	8.355-05	9.158-05	1.028-04	1.240-04	1.529-04	1.732-04	1.865-04	1.955-04	2.078-04	2.122-04
20	383	1.831-06	1.319-06	9.302-07	5.304-07	2.360-07	1.287-07	7.804-08	5.133-08	2.364-08	1.340-08
20	384	2.579-06	1.881-06	1.342-06	7.849-07	3.952-07	2.609-07	2.045-07	1.728-07	1.345-07	1.330-07
20	385	3.356-06	2.441-06	1.738-06	1.007-06	4.547-07	2.501-07	1.531-07	1.017-07	4.802-08	2.764-08
20	386	8.717-07	5.872-07	3.980-07	2.316-07	1.568-07	1.562-07	1.677-07	1.811-07	2.135-07	2.428-07
20	387	1.358-06	8.732-07	5.449-07	2.445-07	8.037-08	4.180-08	2.725-08	1.895-08	7.269-09	3.105-09

Table VII—continued ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
20	388	2.020-06	1.480-06	1.254-06	1.331-06	2.062-06	2.655-06	3.147-06	3.318-06	3.337-06	3.813-06
20	389	2.868-06	3.289-06	4.671-06	8.196-06	1.552-05	2.052-05	2.452-05	2.597-05	2.628-05	3.005-05
20	390	1.435-06	9.306-07	5.866-07	2.681-07	9.080-08	4.752-08	3.080-08	2.129-08	8.184-09	3.641-09
20	391	3.854-06	2.786-06	1.979-06	1.136-06	5.417-07	3.212-07	2.154-07	1.562-07	8.514-08	5.473-08
20	392	2.453-06	1.824-06	1.356-06	8.870-07	6.115-07	5.703-07	5.988-07	6.553-07	8.278-07	9.867-07
20	393	7.668-07	5.538-07	3.923-07	2.235-07	1.054-07	6.159-08	4.084-08	2.942-08	1.589-08	1.014-08
20	395	1.241-04	1.343-04	1.493-04	1.817-04	2.556-04	3.389-04	4.255-04	5.113-04	7.110-04	8.795-04
20	397	4.359-06	3.027-06	2.059-06	1.121-06	4.573-07	2.413-07	1.468-07	9.723-08	4.277-08	2.263-08
20	399	5.629-06	3.892-06	2.630-06	1.443-06	5.841-07	3.063-07	1.895-07	1.276-07	5.618-08	3.312-08
20	400	6.934-06	4.802-06	3.254-06	1.763-06	7.121-07	3.733-07	2.261-07	1.494-07	6.552-08	3.464-08
20	401	1.559-06	1.033-06	6.559-07	3.074-07	1.006-07	4.607-08	2.709-08	1.864-08	1.156-08	5.158-09
20	403	2.851-06	1.888-06	1.201-06	5.680-07	1.932-07	9.367-08	5.928-08	4.390-08	2.963-08	3.088-08
20	405	2.197-06	1.455-06	9.278-07	4.335-07	1.424-07	6.353-08	3.550-08	2.357-08	1.191-08	6.783-09
20	407	2.121-06	1.519-06	1.050-06	5.683-07	2.329-07	1.195-07	6.883-08	4.332-08	1.826-08	9.643-09
20	408	3.648-06	2.620-06	1.817-06	9.937-07	4.107-07	2.141-07	1.279-07	8.303-08	3.552-08	2.451-08
20	409	5.368-06	3.868-06	2.700-06	1.490-06	6.270-07	3.305-07	1.958-07	1.262-07	5.498-08	3.008-08
20	410	1.943-05	1.538-05	1.202-05	8.117-06	4.389-06	2.796-06	1.953-06	1.442-06	7.747-07	4.626-07
20	412	2.374-06	1.593-06	1.030-06	4.926-07	1.677-07	7.864-08	4.584-08	3.120-08	1.618-08	9.208-09
20	414	2.573-06	2.921-06	4.131-06	6.403-06	1.046-05	1.241-05	1.306-05	1.261-05	1.353-05	1.985-05
20	415	8.143-07	6.228-07	4.699-07	3.119-07	2.071-07	1.778-07	1.677-07	1.631-07	1.576-07	1.554-07
20	416	2.005-06	1.430-06	9.692-07	4.902-07	1.792-07	9.092-08	5.690-08	4.047-08	2.169-08	1.298-08
20	418	3.440-06	2.458-06	1.670-06	8.573-07	3.192-07	1.810-07	1.345-07	1.125-07	1.126-07	1.425-07
20	419	3.766-06	3.407-06	3.331-06	4.302-06	1.078-05	1.935-05	2.799-05	3.273-05	5.819-05	1.004-04
20	421	1.246-06	8.300-07	5.227-07	2.667-07	1.320-07	7.315-08	4.208-08	2.688-08	1.484-08	1.324-08
20	423	1.613-06	1.063-06	6.740-07	3.395-07	1.615-07	8.543-08	4.705-08	2.709-08	8.296-09	3.608-09
20	424	1.997-06	1.308-06	8.470-07	4.151-07	1.875-07	1.090-07	6.008-08	3.185-08	9.954-09	3.991-09
20	425	4.316-06	3.615-06	2.966-06	2.151-06	1.239-06	7.913-07	5.381-07	3.828-07	1.897-07	1.068-07
20	426	1.807-06	1.366-06	9.792-07	5.228-07	1.836-07	8.597-08	4.792-08	2.956-08	1.158-08	5.465-09
20	428	2.552-06	1.951-06	1.411-06	7.363-07	2.885-07	1.316-07	8.564-08	6.705-08	4.774-08	5.193-08
20	429	3.253-06	2.441-06	1.752-06	9.405-07	3.330-07	1.576-07	8.768-08	5.401-08	2.125-08	9.892-09
20	430	5.610-05	5.416-05	5.293-05	5.341-05	6.009-05	6.988-05	7.922-05	8.762-05	1.037-04	1.148-04
20	431	1.664-06	1.105-06	7.082-07	3.601-07	1.645-07	8.769-08	4.831-08	2.756-08	8.854-09	3.818-09
20	432	9.403-06	1.059-05	1.188-05	1.385-05	1.666-05	1.828-05	1.945-05	1.916-05	2.362-05	3.147-05
20	433	7.792-05	6.413-05	5.164-05	3.638-05	2.081-05	1.365-05	9.663-06	7.185-06	3.929-06	2.435-06
20	434	5.759-06	4.004-06	2.776-06	1.545-06	5.714-07	2.660-07	1.425-07	8.348-08	2.978-08	1.362-08
20	435	6.947-06	4.998-06	3.537-06	1.876-06	6.970-07	3.327-07	1.784-07	1.037-07	3.847-08	1.967-08
20	436	8.393-06	5.837-06	4.048-06	2.256-06	8.302-07	3.868-07	2.072-07	1.210-07	4.331-08	1.975-08
20	437	1.518-06	1.113-06	7.744-07	4.362-07	2.112-07	1.275-07	8.000-08	5.103-08	1.832-08	7.357-09
20	438	9.118-07	6.684-07	4.690-07	2.691-07	1.342-07	8.546-08	5.729-08	4.002-08	2.252-08	1.842-08
20	439	2.116-06	1.565-06	1.093-06	6.065-07	3.111-07	1.938-07	1.137-07	6.681-08	2.921-08	1.594-08
20	440	1.664-06	1.214-06	8.410-07	4.701-07	2.226-07	1.329-07	8.362-08	5.372-08	1.975-08	8.187-09
20	441	2.052-06	2.639-06	3.039-06	5.032-06	7.446-06	8.501-06	8.936-06	9.078-06	8.890-06	9.111-06
20	442	1.086-06	9.239-07	7.352-07	4.662-07	2.069-07	1.019-07	5.359-08	2.963-08	8.445-09	2.992-09
20	443	3.342-06	2.883-06	2.358-06	1.619-06	9.429-07	6.960-07	5.999-07	5.641-07	5.642-07	5.917-07
20	444	5.374-06	4.563-06	3.636-06	2.309-06	1.024-06	5.040-07	2.653-07	1.473-07	4.213-08	1.500-08
20	445	1.733-04	2.224-04	2.857-04	4.009-04	5.686-04	6.921-04	7.745-04	8.381-04	9.565-04	1.036-03
20	446	1.478-03	1.507-03	1.562-03	1.682-03	1.857-03	1.982-03	2.071-03	2.138-03	2.251-03	2.324-03
20	447	2.269-06	1.843-06	1.489-06	1.026-06	5.796-07	3.666-07	2.505-07	1.801-07	8.950-08	5.044-08
20	448	8.340-06	8.380-06	8.701-06	9.558-06	1.143-05	1.308-05	1.438-05	1.552-05	1.780-05	1.946-05
20	449	1.365-05	1.114-05	9.031-06	6.249-06	3.550-06	2.252-06	1.541-06	1.109-06	5.520-07	3.123-07
20	450	1.129-05	1.293-05	1.496-05	1.867-05	2.478-05	2.954-05	3.313-05	3.616-05	4.215-05	4.643-05
20	451	5.123-06	4.147-06	3.290-06	2.243-06	1.200-06	7.414-07	4.980-07	3.546-07	1.809-07	1.056-07
20	452	5.484-06	4.447-06	3.535-06	2.419-06	1.305-06	8.125-07	5.500-07	3.940-07	2.031-07	1.201-07
20	453	1.491-05	1.307-05	1.153-05	9.848-06	8.428-06	7.979-06	7.828-06	7.815-06	7.937-06	8.026-06
20	454	1.005-06	9.619-07	9.855-07	1.182-06	1.772-06	2.360-06	2.820-06	3.175-06	3.750-06	4.049-06
20	455	3.052-06	2.476-06	1.965-06	1.339-06	7.104-07	4.351-07	2.901-07	2.051-07	1.035-07	6.055-08
20	456	8.095-06	7.021-06	5.930-06	4.420-06	2.642-06	1.755-06	1.245-06	9.232-07	5.043-07	3.111-07
20	457	1.048-04	1.052-04	1.069-04	1.110-04	1.155-04	1.183-04	1.201-04	1.214-04	1.237-04	1.251-04
20	458	4.564-06	3.688-06	2.918-06	1.989-06	1.083-06	7.048-07	5.140-07	4.079-07	2.897-07	2.389-07

Table VII—continued ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
20	459	2.163-05	1.739-05	1.373-05	9.331-06	5.010-06	3.121-06	2.110-06	1.506-06	7.682-07	4.490-07
20	460	2.912-05	2.322-05	1.821-05	1.204-05	6.468-06	3.970-06	2.640-06	1.847-06	8.625-07	4.599-07
20	461	2.168-05	2.132-05	2.126-05	2.189-05	2.349-05	2.490-05	2.599-05	2.693-05	2.867-05	2.957-05
20	462	1.302-04	1.211-04	1.161-04	1.151-04	1.264-04	1.422-04	1.581-04	1.734-04	2.075-04	2.348-04
20	463	1.348-04	1.059-04	8.203-05	5.317-05	2.771-05	1.670-05	1.096-05	7.593-06	3.461-06	1.792-06
20	464	6.511-06	5.471-06	4.491-06	3.216-06	1.823-06	1.166-06	8.036-07	5.842-07	3.091-07	1.859-07
20	465	2.383-05	1.850-05	1.419-05	9.125-06	4.608-06	2.738-06	1.787-06	1.241-06	5.929-07	3.294-07
20	466	1.800-05	1.381-05	1.062-05	7.226-06	4.555-06	3.724-06	3.426-06	3.322-06	3.349-06	3.510-06
20	467	2.652-05	2.221-05	1.823-05	1.306-05	7.580-06	4.905-06	3.394-06	2.467-06	1.302-06	7.969-07
20	468	3.051-04	3.549-04	4.134-04	5.134-04	6.713-04	7.996-04	9.066-04	1.000-03	1.194-03	1.344-03
20	469	9.648-06	8.011-06	6.553-06	4.779-06	2.968-06	2.186-06	1.796-06	1.587-06	1.377-06	1.316-06
20	471	1.608-04	1.601-04	1.610-04	1.646-04	1.671-04	1.683-04	1.689-04	1.693-04	1.704-04	1.712-04
20	472	3.650-04	4.569-04	5.655-04	7.581-04	1.087-03	1.371-03	1.621-03	1.849-03	2.334-03	2.705-03
20	474	5.114-08	2.851-08	1.512-08	5.610-09	1.305-09	4.880-10	2.256-10	1.169-10	3.934-11	1.831-11
20	475	1.085-07	6.070-08	3.251-08	1.209-08	2.961-09	1.019-09	4.114-10	1.920-10	3.995-11	2.145-11
20	477	2.035-05	1.481-05	1.066-05	6.186-06	2.755-06	1.522-06	9.476-07	6.375-07	2.877-07	1.519-07
20	478	2.749-05	2.920-05	3.179-05	3.701-05	4.470-05	5.046-05	5.462-05	5.761-05	6.191-05	6.360-05
20	479	8.176-06	5.684-06	3.891-06	2.095-06	8.501-07	4.471-07	2.687-07	1.760-07	7.719-08	4.064-08
20	480	8.948-06	6.519-06	4.891-06	3.438-06	2.721-06	2.669-06	2.717-06	2.779-06	2.911-06	2.996-06
20	481	2.276-06	1.832-06	1.441-06	9.673-07	4.942-07	2.906-07	1.870-07	1.285-07	6.204-08	3.509-08
20	482	4.760-06	4.530-06	4.531-06	4.781-06	5.315-06	5.566-06	5.699-06	5.772-06	5.993-06	6.112-06
20	483	5.102-06	3.484-06	2.344-06	1.220-06	4.791-07	2.398-07	1.369-07	8.530-08	3.257-08	1.532-08
20	484	9.335-07	5.707-07	3.415-07	1.490-07	4.857-08	2.244-08	1.226-08	7.479-09	2.918-09	1.466-09
20	485	1.132-06	7.193-07	4.579-07	2.417-07	1.445-07	1.187-07	5.894-08	4.543-08	9.777-08	8.779-08
20	486	2.992-05	2.286-05	1.734-05	1.102-05	5.359-06	3.129-06	2.028-06	1.412-06	7.034-07	4.108-07
20	487	1.538-05	1.157-05	8.630-06	5.323-06	2.448-06	1.370-06	8.571-07	5.803-07	2.781-07	1.618-07
20	488	2.013-05	1.504-05	1.111-05	6.776-06	3.113-06	1.791-06	1.193-06	8.835-07	5.667-07	4.618-07
20	489	2.894-05	2.249-05	1.743-05	1.147-05	5.850-06	3.536-06	2.350-06	1.668-06	8.587-07	5.158-07
20	490	2.528-05	2.087-05	1.754-05	1.375-05	1.048-05	9.458-06	9.148-06	9.137-06	9.558-06	1.011-05
20	491	9.180-06	7.244-06	5.712-06	3.862-06	2.047-06	1.269-06	8.586-07	6.173-07	3.234-07	1.954-07
20	492	1.212-05	9.913-06	8.533-06	7.840-06	8.705-06	9.906-06	1.093-05	1.176-05	1.334-05	1.463-05
20	493	3.515-04	3.866-04	4.288-04	4.985-04	5.990-04	6.727-04	7.309-04	7.782-04	8.692-04	9.407-04
20	494	5.093-08	2.700-08	1.375-08	4.758-09	1.149-09	4.493-10	2.114-10	1.101-10	2.959-11	1.330-11
20	497	9.581-08	5.265-08	2.768-08	9.922-09	2.357-09	8.092-10	3.249-10	1.474-10	2.636-11	1.349-11
20	498	9.110-06	6.289-06	4.271-06	2.259-06	8.870-07	4.585-07	2.755-07	1.823-07	8.210-08	4.378-08
20	500	7.921-08	4.542-08	2.474-08	9.503-09	2.155-09	8.013-10	3.701-10	1.864-10	7.244-11	3.327-11
20	501	1.503-07	9.089-08	5.358-08	2.355-08	7.409-09	3.242-09	1.697-09	1.016-09	4.016-10	2.123-10
20	503	9.425-06	6.456-06	4.399-06	2.446-06	1.259-06	9.696-07	8.745-07	8.372-07	8.166-07	8.295-07
20	504	2.156-05	1.570-05	1.131-05	6.576-06	2.938-06	1.629-06	1.018-06	6.877-07	3.134-07	1.671-07
20	505	2.197-05	1.920-05	1.754-05	1.662-05	1.712-05	1.832-05	1.939-05	2.022-05	2.146-05	2.194-05
20	506	1.741-05	1.292-05	9.499-06	5.691-06	2.637-06	1.487-06	9.373-07	6.350-07	2.895-07	1.543-07
20	507	1.422-05	9.984-06	6.905-06	3.795-06	1.592-06	8.520-07	5.145-07	3.361-07	1.454-07	7.623-08
20	508	5.204-05	5.782-05	6.494-05	7.781-05	9.561-05	1.085-04	1.178-04	1.244-04	1.339-04	1.375-04
20	509	9.654-06	7.554-06	6.274-06	5.350-06	5.308-06	5.674-06	5.986-06	6.234-06	6.657-06	6.894-06
20	510	4.018-06	3.625-06	3.477-06	3.520-06	3.824-06	3.986-06	4.074-06	4.124-06	4.263-06	4.331-06
20	511	4.159-06	2.775-06	1.820-06	9.039-07	3.332-07	1.595-07	8.737-08	5.238-08	1.824-08	7.877-09
20	512	4.691-06	3.191-06	2.131-06	1.088-06	4.139-07	1.999-07	1.098-07	6.577-08	2.285-08	9.940-09
20	513	8.222-06	7.710-06	7.587-06	7.832-06	8.584-06	8.957-06	9.158-06	9.269-06	9.591-06	9.766-06
20	514	1.015-06	6.123-07	3.609-07	1.514-07	4.503-08	2.023-08	1.110-08	6.873-09	2.723-09	1.309-09
20	515	1.229-06	7.565-07	4.620-07	2.212-07	1.083-07	8.940-08	8.606-08	7.826-08	5.698-08	6.402-08
20	516	1.351-06	9.045-07	6.176-07	3.774-07	2.802-07	2.709-07	2.792-07	2.616-07	1.913-07	2.136-07
20	517	1.633-06	1.022-06	6.296-07	2.917-07	1.044-07	4.974-08	2.719-08	1.644-08	6.355-09	3.223-09
20	518	5.011-07	4.080-07	3.264-07	2.229-07	1.247-07	7.853-08	5.327-08	3.790-08	1.834-08	1.009-08
20	519	7.619-06	9.353-06	1.145-05	1.523-05	2.179-05	2.747-05	3.248-05	3.706-05	4.677-05	5.422-05
20	520	1.988-06	1.554-06	1.196-06	7.697-07	3.947-07	2.357-07	1.539-07	1.065-07	4.978-08	2.705-08
20	521	1.102-04	8.915-05	7.107-05	4.843-05	2.623-05	1.631-05	1.108-05	7.985-06	4.152-06	2.481-06
20	522	1.887-04	1.532-04	1.225-04	8.431-05	4.656-05	2.991-05	2.124-05	1.608-05	9.624-06	6.902-06
20	523	2.695-04	2.183-04	1.742-04	1.189-04	6.460-05	4.025-05	2.737-05	1.975-05	1.028-05	6.145-06
20	524	7.383-07	5.480-07	4.036-07	2.481-07	1.290-07	9.294-08	8.083-08	7.444-08	6.575-08	6.682-08



Table VII—continued ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
20	525	6.311-07	5.302-07	4.368-07	3.098-07	1.797-07	1.152-07	7.890-08	5.652-08	2.788-08	1.571-08
20	526	3.770-06	3.978-06	4.289-06	4.940-06	6.296-06	7.643-06	8.922-06	1.014-05	1.283-05	1.499-05
20	527	3.972-07	3.216-07	2.595-07	1.814-07	1.010-07	6.395-08	4.410-08	3.222-08	1.721-08	1.054-08
20	528	9.198-04	1.040-03	1.169-03	1.382-03	1.675-03	1.876-03	2.017-03	2.119-03	2.303-03	2.428-03
20	529	1.568-07	1.409-07	1.301-07	1.187-07	1.064-07	9.933-08	9.476-08	9.238-08	9.197-08	9.418-08
20	530	8.255-07	6.319-07	4.769-07	2.985-07	1.458-07	8.468-08	5.435-08	3.725-08	1.730-08	9.450-09
20	531	1.063-04	7.761-05	5.553-05	3.175-05	1.371-05	7.152-06	4.151-06	2.593-06	9.932-07	4.666-07
20	532	1.481-04	1.086-04	7.843-05	4.504-05	1.968-05	1.049-05	6.348-06	4.204-06	1.969-06	1.258-06
20	533	1.920-04	1.403-04	1.004-04	5.746-05	2.484-05	1.296-05	7.527-06	4.705-06	1.804-06	8.481-07
20	534	3.234-04	3.931-04	4.572-04	5.460-04	6.561-04	7.076-04	7.321-04	7.439-04	7.641-04	7.737-04
20	535	9.591-06	8.595-06	7.908-06	7.146-06	6.574-06	6.402-06	6.372-06	6.455-06	6.633-06	6.630-06
20	536	2.364-05	2.654-05	2.970-05	3.493-05	4.222-05	4.722-05	5.072-05	5.327-05	5.790-05	6.101-05
20	537	1.902-06	1.502-06	1.169-06	7.652-07	3.915-07	2.343-07	1.550-07	1.098-07	5.604-08	3.343-08
20	538	3.739-06	3.082-06	2.504-06	1.762-06	9.961-07	6.364-07	4.400-07	3.210-07	1.695-07	1.019-07
20	539	9.951-08	6.751-08	4.652-08	2.866-08	2.191-08	2.149-08	2.166-08	2.065-08	2.131-08	3.116-08
20	540	1.033-05	9.708-06	9.249-06	8.821-06	8.629-06	8.789-06	8.998-06	9.195-06	9.660-06	1.003-05
20	541	3.532-06	2.956-06	2.442-06	1.764-06	1.036-06	6.784-07	4.770-07	3.520-07	1.891-07	1.148-07
20	542	2.476-06	2.139-06	1.829-06	1.399-06	8.794-07	6.001-07	4.335-07	3.262-07	1.815-07	1.130-07
20	543	8.036-07	6.983-07	6.037-07	4.738-07	3.228-07	2.500-07	2.119-07	1.909-07	1.655-07	1.513-07
20	544	4.869-07	4.108-07	3.426-07	2.499-07	1.430-07	9.037-08	6.106-08	4.342-08	2.196-08	1.298-08
20	545	7.305-07	7.313-07	7.547-07	8.361-07	1.018-06	1.185-06	1.322-06	1.436-06	1.645-06	1.786-06
20	546	1.011-06	8.112-07	6.434-07	4.380-07	2.400-07	1.516-07	1.044-07	7.613-08	4.021-08	2.414-08
20	547	1.770-06	1.307-06	9.456-07	5.510-07	2.436-07	1.297-07	7.675-08	4.879-08	1.937-08	9.359-09
20	548	3.811-06	4.127-06	4.464-06	4.998-06	5.775-06	6.176-06	6.374-06	6.475-06	6.631-06	6.682-06
20	549	3.716-06	3.907-06	4.141-06	4.545-06	5.192-06	5.516-06	5.670-06	5.743-06	5.872-06	5.928-06
20	550	2.932-06	2.125-06	1.508-06	8.512-07	3.623-07	1.869-07	1.074-07	6.652-08	2.491-08	1.148-08
20	551	3.021-07	3.708-07	4.670-07	6.541-07	9.471-07	1.169-06	1.324-06	1.445-06	1.666-06	1.818-06
20	552	1.021-07	7.789-08	5.790-08	3.453-08	1.491-08	7.765-09	4.538-09	2.889-09	1.228-09	6.581-10
20	553	3.951-08	2.723-08	1.937-08	1.476-08	1.417-08	1.466-08	1.483-08	1.479-08	1.415-08	1.450-08
20	554	7.549-08	5.173-08	3.489-08	1.841-08	7.072-09	3.467-09	1.933-09	1.170-09	4.253-10	1.908-10
20	555	2.076-05	2.417-05	2.781-05	3.381-05	4.200-05	4.757-05	5.152-05	5.446-05	5.907-05	6.127-05
20	556	5.847-07	4.480-07	3.361-07	2.071-07	9.699-08	5.386-08	3.309-08	2.179-08	9.362-09	4.801-09
20	557	1.033-06	1.110-06	1.188-06	1.304-06	1.470-06	1.555-06	1.592-06	1.607-06	1.660-06	1.708-06
20	558	1.875-07	1.281-07	8.633-08	4.489-08	1.704-08	8.204-09	4.607-09	2.925-09	1.343-09	8.035-10
20	559	3.339-07	2.441-07	1.814-07	1.203-07	8.871-08	8.094-08	8.416-08	8.733-08	9.987-08	1.143-07

TABLE VIII:

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
1	2	6.724-02	2.139-01	2.335-01	1.958-01	1.253-01	9.269-02	7.719-02	6.914-02	6.121-02	5.893-02
1	3	1.650-02	1.489-02	1.309-02	1.025-02	6.759-03	4.859-03	3.722-03	2.995-03	2.027-03	1.577-03
1	4	2.315-02	2.080-02	1.819-02	1.406-02	8.981-03	6.205-03	4.535-03	3.459-03	2.009-03	1.318-03
1	5	1.388-02	1.247-02	1.090-02	8.420-03	5.373-03	3.707-03	2.705-03	2.059-03	1.188-03	7.726-04
1	6	2.564-02	2.300-02	2.007-02	1.555-02	9.980-03	6.911-03	5.056-03	3.859-03	2.266-03	1.501-03
1	7	6.374-01	6.883-01	7.419-01	8.268-01	9.505-01	1.038+00	1.104+00	1.158+00	1.261+00	1.337+00
1	8	3.672-01	3.939-01	4.229-01	4.696-01	5.396-01	5.904-01	6.296-01	6.616-01	7.231-01	7.686-01
1	9	5.617-01	6.022-01	6.466-01	7.183-01	8.268-01	9.057-01	9.670-01	1.017+00	1.113+00	1.184+00
1	10	3.263-01	3.491-01	3.742-01	4.146-01	4.760-01	5.209-01	5.558-01	5.844-01	6.392-01	6.800-01
1	11	1.119-03	9.389-04	7.585-04	5.190-04	2.876-04	1.749-04	1.158-04	8.179-05	4.093-05	2.499-05
1	12	3.740-03	3.996-03	4.259-03	4.525-03	8.712-03	6.551-03	6.177-03	6.325-03	5.902-03	6.069-03
1	13	3.125-03	3.141-03	3.162-03	3.138-03	5.484-03	4.094-03	3.823-03	3.886-03	3.600-03	3.688-03
1	14	2.932-03	2.881-03	2.811-03	2.702-03	2.599-03	2.543-03	2.507-03	2.481-03	2.443-03	2.431-03
1	15	1.866-03	1.904-03	1.947-03	2.034-03	2.235-03	2.932-03	2.644-03	2.375-03	2.463-03	2.427-03
1	16	5.196-03	5.357-03	5.696-03	6.615-03	8.720-03	1.068-02	1.260-02	1.430-02	1.780-02	2.066-02
1	17	4.612-02	4.606-02	4.585-02	4.552-02	4.545-02	4.548-02	4.549-02	4.550-02	4.551-02	4.551-02
1	18	2.241-02	2.066-02	1.893-02	1.684-02	1.518-02	1.473-02	1.477-02	1.537-02	1.673-02	1.647-02
1	19	1.736-01	1.905-01	2.111-01	2.505-01	3.177-01	3.727-01	4.189-01	4.598-01	5.442-01	6.089-01
1	20	3.759-02	3.216-02	2.722-02	2.119-02	1.599-02	1.398-02	1.307-02	1.318-02	1.408-02	1.345-02
1	21	3.453-03	2.926-03	2.402-03	1.704-03	1.015-03	6.908-04	5.108-04	3.998-04	2.540-04	1.855-04
1	22	4.372-03	3.690-03	3.015-03	2.115-03	1.226-03	8.079-04	5.759-04	4.330-04	2.455-04	1.571-04
1	23	7.765-05	6.517-05	5.326-05	3.744-05	2.138-05	1.379-05	9.598-06	7.039-06	3.776-06	2.310-06
1	24	1.051-01	1.092-01	1.131-01	1.186-01	1.256-01	1.294-01	1.318-01	1.333-01	1.356-01	1.368-01
1	25	6.921-04	5.890-04	4.894-04	3.609-04	2.421-04	1.911-04	1.669-04	1.632-04	1.692-04	1.510-04
1	26	4.581-03	5.154-03	5.950-03	7.613-03	1.081-02	1.357-02	1.605-02	1.831-02	2.299-02	2.661-02
1	27	4.337-03	4.270-03	4.322-03	4.650-03	5.620-03	6.641-03	7.632-03	8.577-03	1.060-02	1.220-02
1	28	4.557-03	5.674-03	7.101-03	9.890-03	1.496-02	1.917-02	2.289-02	2.625-02	3.314-02	3.845-02
1	29	3.780-03	4.391-03	5.210-03	6.875-03	1.001-02	1.268-02	1.506-02	1.723-02	2.170-02	2.514-02
1	30	2.979-03	2.548-03	2.140-03	1.569-03	9.304-04	6.102-04	4.275-04	3.141-04	1.673-04	9.995-05
1	31	9.525-06	7.587-06	5.866-06	3.759-06	1.865-06	1.080-06	6.841-07	4.604-07	2.039-07	1.060-07
1	32	1.669-03	1.462-03	1.273-03	1.021-03	7.721-04	6.778-04	6.478-04	6.484-04	6.961-04	7.573-04
1	33	1.439-03	1.240-03	1.051-03	7.887-04	4.947-04	3.544-04	2.761-04	2.304-04	1.803-04	1.636-04
1	34	1.579-03	1.362-03	1.156-03	8.682-04	5.497-04	3.949-04	3.111-04	2.627-04	2.091-04	1.924-04
1	35	1.128-03	9.690-04	8.174-04	6.025-04	3.595-04	2.367-04	1.663-04	1.224-04	6.535-05	3.918-05
1	36	1.473-02	1.914-02	2.477-02	3.574-02	5.574-02	7.239-02	8.709-02	1.004-01	1.278-01	1.488-01
1	37	2.974-04	2.594-04	2.234-04	1.727-04	1.168-04	8.944-05	7.395-05	6.435-05	5.247-05	4.797-05
1	38	8.201-03	6.919-03	5.685-03	4.042-03	2.373-03	1.593-03	1.166-03	9.096-04	5.902-04	4.497-04
1	39	9.742-03	8.204-03	6.715-03	4.725-03	2.698-03	1.755-03	1.231-03	9.126-04	5.148-04	3.393-04
1	40	7.842-03	6.592-03	5.389-03	3.785-03	2.150-03	1.381-03	9.574-04	7.011-04	3.785-04	2.340-04
1	41	2.486-03	3.263-03	4.262-03	6.231-03	9.863-03	1.291-02	1.561-02	1.808-02	2.316-02	2.706-02
1	42	5.665-06	4.513-06	3.514-06	2.290-06	1.188-06	7.250-07	4.845-07	3.433-07	1.702-07	9.718-08
1	43	2.556-03	2.141-03	1.744-03	1.219-03	6.884-04	4.417-04	3.071-04	2.262-04	1.251-04	8.027-05
1	44	5.405-03	4.559-03	3.746-03	2.671-03	1.597-03	1.108-03	8.428-04	6.847-04	4.944-04	4.161-04
1	45	9.072-03	7.778-03	6.550-03	4.954-03	3.405-03	2.722-03	2.376-03	2.184-03	1.977-03	1.907-03
1	46	3.164-03	2.647-03	2.153-03	1.499-03	8.408-04	5.352-04	3.686-04	2.686-04	1.437-04	8.822-05
1	47	1.781-02	2.003-02	2.248-02	2.662-02	3.266-02	3.658-02	3.952-02	4.175-02	4.549-02	4.780-02
1	48	1.234-02	1.330-02	1.441-02	1.639-02	1.947-02	2.154-02	2.314-02	2.437-02	2.645-02	2.774-02
1	49	4.132-03	4.167-03	4.245-03	4.468-03	4.949-03	5.325-03	5.640-03	5.893-03	6.340-03	6.630-03
1	50	1.027-03	9.324-04	8.450-04	7.406-04	6.603-04	6.386-04	6.372-04	6.425-04	6.620-04	6.792-04
1	51	1.304-04	1.131-04	9.652-05	7.472-05	5.315-05	4.335-05	3.809-05	3.498-05	3.121-05	2.961-05
1	52	2.043-02	2.128-02	2.209-02	2.328-02	2.481-02	2.570-02	2.626-02	2.664-02	2.720-02	2.749-02
1	53	2.272-03	2.061-03	1.859-03	1.614-03	1.435-03	1.381-03	1.373-03	1.382-03	1.423-03	1.457-03
1	54	4.179-02	4.739-02	5.355-02	6.388-02	7.898-02	8.873-02	9.601-02	1.016-01	1.109-01	1.167-01
1	55	1.050-03	8.801-04	7.177-04	5.030-04	2.860-04	1.847-04	1.293-04	9.596-05	5.446-05	3.607-05
1	56	1.521-02	1.712-02	1.924-02	2.282-02	2.811-02	3.155-02	3.412-02	3.609-02	3.942-02	4.145-02
1	57	5.935-04	5.501-04	5.099-04	4.613-04	4.217-04	4.090-04	4.040-04	4.023-04	4.028-04	4.044-04
1	58	1.285-03	1.583-03	1.982-03	2.803-03	4.387-03	5.757-03	6.984-03	8.116-03	1.049-02	1.232-02
1	59	1.227-03	1.095-03	9.731-04	8.122-04	6.550-04	6.047-04	5.948-04	6.056-04	6.650-04	7.299-04
1	60	1.997-03	1.755-03	1.512-03	1.151-03	7.232-04	4.964-04	3.633-04	2.790-04	1.699-04	1.225-04

Table VIII—*continued* ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
1	61	1.395-03	1.719-03	2.168-03	3.106-03	4.981-03	6.609-03	8.089-03	9.459-03	1.231-02	1.450-02
1	62	1.415-03	1.517-03	1.661-03	1.967-03	2.561-03	3.083-03	3.546-03	3.972-03	4.869-03	5.558-03
1	63	3.633-05	3.297-05	2.980-05	2.588-05	2.304-05	2.294-05	2.390-05	2.538-05	2.946-05	3.308-05
1	64	4.346-05	3.803-05	3.252-05	2.446-05	1.519-05	1.042-05	7.668-06	5.961-06	3.802-06	2.864-06
1	65	2.707-05	2.342-05	1.976-05	1.452-05	8.690-06	5.747-06	4.053-06	3.000-06	1.644-06	1.027-06
1	66	6.444-03	5.383-03	4.371-03	3.044-03	1.716-03	1.103-03	7.720-04	5.744-04	3.312-04	2.251-04
1	67	1.137-02	1.233-02	1.343-02	1.541-02	1.852-02	2.064-02	2.227-02	2.354-02	2.574-02	2.713-02
1	68	7.624-03	8.293-03	9.063-03	1.043-02	1.257-02	1.401-02	1.511-02	1.597-02	1.749-02	1.844-02
1	69	6.917-03	7.093-03	7.342-03	7.899-03	8.971-03	9.773-03	1.042-02	1.094-02	1.190-02	1.251-02
1	70	2.868-04	3.486-04	4.333-04	6.076-04	9.545-04	1.258-03	1.530-03	1.786-03	2.325-03	2.731-03
1	71	1.443-03	1.253-03	1.068-03	8.227-04	5.738-04	4.582-04	3.944-04	3.562-04	3.102-04	2.861-04
1	72	5.930-03	6.283-03	6.708-03	7.505-03	8.831-03	9.758-03	1.048-02	1.105-02	1.205-02	1.270-02
1	73	2.300-04	2.585-04	3.008-04	3.922-04	5.844-04	7.579-04	9.157-04	1.066-03	1.385-03	1.626-03
1	74	4.314-05	3.658-05	2.996-05	2.087-05	1.172-05	7.445-06	5.156-06	3.823-06	2.261-06	1.639-06
1	75	1.212-04	1.053-04	8.881-05	6.525-05	3.978-05	2.693-05	1.953-05	1.493-05	8.998-06	6.345-06
1	76	2.071-04	1.805-04	1.529-04	1.136-04	7.119-05	4.990-05	3.779-05	3.028-05	2.064-05	1.645-05
1	77	2.204-04	1.916-04	1.618-04	1.190-04	7.250-05	4.889-05	3.525-05	2.671-05	1.560-05	1.058-05
1	78	6.179-05	5.275-05	4.394-05	3.172-05	1.878-05	1.255-05	9.059-06	6.928-06	4.258-06	3.082-06
1	79	9.021-05	1.001-04	1.158-04	1.510-04	2.293-04	3.007-04	3.660-04	4.291-04	5.627-04	6.620-04
1	80	1.800-04	1.568-04	1.327-04	9.805-05	5.987-05	4.026-05	2.880-05	2.156-05	1.205-05	7.676-06
1	81	6.525-05	5.705-05	4.839-05	3.583-05	2.224-05	1.522-05	1.109-05	8.466-06	4.941-06	3.261-06
1	82	1.304-04	1.142-04	9.722-05	7.283-05	4.670-05	3.349-05	2.587-05	2.111-05	1.492-05	1.209-05
1	83	1.663-04	1.447-04	1.222-04	8.993-05	5.476-05	3.690-05	2.658-05	2.011-05	1.172-05	7.972-06
1	84	1.231-04	1.074-04	9.168-05	7.092-05	5.133-05	4.392-05	4.071-05	3.906-05	3.932-05	4.215-05
1	85	1.105-04	1.003-04	9.035-05	7.746-05	6.615-05	6.287-05	6.180-05	6.160-05	6.352-05	6.616-05
1	86	9.164-05	8.913-05	8.728-05	8.671-05	9.116-05	9.722-05	1.020-04	1.060-04	1.145-04	1.204-04
1	87	4.018-04	4.115-04	4.200-04	4.321-04	4.497-04	4.609-04	4.681-04	4.733-04	4.815-04	4.863-04
1	88	6.443-05	5.482-05	4.504-05	3.158-05	1.810-05	1.185-05	8.518-06	6.591-06	4.353-06	3.476-06
1	89	1.988-04	1.649-04	1.328-04	9.186-05	5.382-05	3.802-05	3.052-05	2.671-05	2.345-05	2.318-05
1	90	2.530-04	2.082-04	1.656-04	1.107-04	5.805-05	3.482-05	2.289-05	1.610-05	8.080-06	4.713-06
1	91	2.644-04	2.180-04	1.739-04	1.166-04	6.146-05	3.708-05	2.447-05	1.722-05	8.617-06	5.028-06
1	92	2.021-04	1.675-04	1.343-04	9.095-05	4.863-05	2.970-05	1.979-05	1.402-05	7.085-06	4.163-06
1	93	7.895-04	8.504-04	9.230-04	1.055-03	1.270-03	1.424-03	1.537-03	1.626-03	1.784-03	1.879-03
1	94	5.432-04	4.679-04	3.923-04	2.869-04	1.740-04	1.176-04	8.520-05	6.504-05	3.910-05	2.744-05
1	95	3.079-04	2.808-04	2.565-04	2.312-04	2.225-04	2.318-04	2.467-04	2.633-04	3.039-04	3.393-04
1	96	1.668-04	1.489-04	1.320-04	1.119-04	9.761-05	9.555-05	9.806-05	1.024-04	1.153-04	1.276-04
available on request											
15	172	3.773-04	3.951-04	4.197-04	4.726-04	5.729-04	6.616-04	7.385-04	8.089-04	9.597-04	1.077-03
15	173	4.751-04	5.026-04	5.365-04	6.021-04	7.212-04	8.171-04	8.947-04	9.569-04	1.066-03	1.136-03
15	174	6.746-04	7.399-04	8.143-04	9.401-04	1.131-03	1.261-03	1.359-03	1.434-03	1.559-03	1.632-03
15	175	2.024-04	1.604-04	1.243-04	8.086-05	4.251-05	2.715-05	1.949-05	1.520-05	1.042-05	8.628-06
15	176	2.390-04	2.174-04	2.002-04	1.819-04	1.725-04	1.726-04	1.737-04	1.749-04	1.773-04	1.779-04
15	177	1.726-04	1.326-04	9.933-05	6.071-05	2.800-05	1.535-05	9.223-06	5.912-06	2.387-06	1.157-06
15	178	1.929-04	2.086-04	2.269-04	2.589-04	3.096-04	3.463-04	3.754-04	3.983-04	4.362-04	4.568-04
15	179	3.369-04	3.462-04	3.593-04	3.834-04	4.264-04	4.559-04	4.743-04	4.868-04	5.036-04	5.089-04
15	180	3.821-04	3.719-04	3.689-04	3.802-04	4.260-04	4.771-04	5.245-04	5.696-04	6.701-04	7.508-04
15	181	2.819-04	3.234-04	3.651-04	4.237-04	5.024-04	5.466-04	5.675-04	5.794-04	5.992-04	6.078-04
15	182	1.329-04	1.097-04	8.966-05	6.577-05	4.588-05	3.901-05	3.636-05	3.557-05	3.664-05	3.867-05
15	183	6.186-05	4.900-05	3.775-05	2.407-05	1.183-05	6.784-06	4.269-06	2.865-06	1.278-06	6.779-07
15	184	2.043-03	2.239-03	2.466-03	2.882-03	3.582-03	4.163-03	4.651-03	5.091-03	6.036-03	6.778-03
15	185	5.216-04	5.661-04	6.162-04	7.019-04	8.430-04	9.537-04	1.039-03	1.114-03	1.274-03	1.396-03
15	186	7.322-05	7.677-05	8.268-05	9.622-05	1.238-04	1.498-04	1.741-04	1.975-04	2.503-04	2.930-04
15	187	1.094-04	9.833-05	8.730-05	7.259-05	5.970-05	5.520-05	5.392-05	5.399-05	5.550-05	5.679-05
15	188	1.496-03	1.515-03	1.529-03	1.553-03	1.599-03	1.634-03	1.659-03	1.679-03	1.712-03	1.731-03
15	189	3.978-04	3.659-04	3.395-04	3.166-04	3.170-04	3.337-04	3.543-04	3.752-04	4.227-04	4.622-04
15	190	6.528-05	5.579-05	4.623-05	3.326-05	2.043-05	1.466-05	1.213-05	1.099-05	9.310-06	9.132-06
15	191	1.518-03	1.581-03	1.665-03	1.844-03	2.174-03	2.448-03	2.685-03	2.896-03	3.332-03	3.675-03
15	192	8.667-04	8.776-04	8.868-04	9.025-04	9.326-04	9.547-04	9.712-04	9.837-04	1.003-03	1.016-03
15	193	3.567-05	2.781-05	2.183-05	1.577-05	1.173-05	1.062-05	1.020-05	1.004-05	9.946-06	9.955-06

Table VIII—*continued* ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
15	194	4.897-05	4.287-05	3.880-05	3.558-05	3.540-05	3.652-05	3.732-05	3.786-05	3.910-05	4.009-05
15	195	1.623-04	1.328-04	1.095-04	8.631-05	7.348-05	7.232-05	7.402-05	7.621-05	8.062-05	8.317-05
15	196	2.778-04	2.594-04	2.500-04	2.540-04	2.832-04	3.111-04	3.356-04	3.549-04	3.851-04	4.002-04
15	197	7.659-05	6.941-05	6.346-05	5.775-05	5.702-05	6.136-05	6.709-05	7.323-05	8.755-05	9.969-05
15	198	1.204-04	1.154-04	1.128-04	1.154-04	1.346-04	1.597-04	1.861-04	2.132-04	2.767-04	3.296-04
15	199	9.315-05	9.952-05	1.093-04	1.312-04	1.733-04	2.093-04	2.404-04	2.684-04	3.260-04	3.693-04
15	200	2.738-04	3.193-04	3.786-04	4.948-04	6.952-04	8.543-04	9.856-04	1.100-03	1.326-03	1.488-03
15	201	2.523-04	2.679-04	2.886-04	3.329-04	4.215-04	5.067-04	5.875-04	6.659-04	8.461-04	9.985-04
15	202	9.890-05	9.937-05	1.007-04	1.043-04	1.130-04	1.202-04	1.257-04	1.302-04	1.385-04	1.438-04
15	203	2.025-04	2.113-04	2.220-04	2.411-04	2.729-04	2.953-04	3.113-04	3.237-04	3.459-04	3.597-04
15	204	2.434-04	2.426-04	2.446-04	2.531-04	2.759-04	2.961-04	3.134-04	3.273-04	3.518-04	3.692-04
15	205	1.184-04	1.030-04	8.839-05	6.918-05	5.074-05	4.264-05	3.883-05	3.666-05	3.448-05	3.527-05
15	206	5.565-05	5.676-05	5.881-05	6.371-05	7.388-05	8.260-05	9.021-05	9.658-05	1.073-04	1.139-04
15	207	2.206-04	2.247-04	2.323-04	2.531-04	3.037-04	3.520-04	3.939-04	4.293-04	4.951-04	5.404-04
15	208	7.135-05	6.573-05	6.175-05	5.859-05	5.952-05	6.242-05	6.501-05	6.716-05	7.024-05	7.114-05
15	209	9.214-05	8.644-05	8.284-05	8.089-05	8.474-05	8.975-05	9.370-05	9.671-05	9.989-05	9.928-05
15	210	2.187-04	1.890-04	1.629-04	1.320-04	1.067-04	9.785-05	9.383-05	9.183-05	9.002-05	8.959-05
15	211	3.120-04	3.073-04	3.068-04	3.114-04	3.297-04	3.461-04	3.558-04	3.623-04	3.730-04	3.780-04
15	212	2.215-04	2.071-04	1.954-04	1.863-04	1.928-04	2.084-04	2.253-04	2.429-04	2.865-04	3.234-04
15	213	8.559-04	8.878-04	9.312-04	1.028-03	1.223-03	1.404-03	1.567-03	1.720-03	2.066-03	2.355-03
15	219	1.444-05	1.326-05	1.232-05	1.137-05	1.111-05	1.164-05	1.233-05	1.307-05	1.470-05	1.584-05
15	228	4.166-05	3.649-05	3.129-05	2.418-05	1.733-05	1.430-05	1.278-05	1.200-05	1.129-05	1.108-05
15	229	2.180-04	2.109-04	2.032-04	1.924-04	1.829-04	1.790-04	1.770-04	1.761-04	1.756-04	1.758-04
15	236	1.404-04	1.273-04	1.160-04	1.047-04	1.009-04	1.042-04	1.093-04	1.148-04	1.275-04	1.381-04
15	237	4.900-04	5.037-04	5.237-04	5.702-04	6.622-04	7.403-04	8.076-04	8.668-04	9.865-04	1.078-03
15	243	5.880-07	3.823-07	2.417-07	1.214-07	7.302-08	7.722-08	9.228-08	9.147-08	9.505-08	1.833-07
15	247	5.747-05	4.587-05	3.659-05	2.724-05	2.177-05	2.102-05	2.150-05	2.222-05	2.370-05	2.457-05
15	248	8.943-05	7.961-05	7.313-05	7.013-05	7.532-05	8.230-05	8.936-05	9.525-05	1.045-04	1.091-04
15	249	6.842-06	4.697-06	3.118-06	1.636-06	7.698-07	5.612-07	4.941-07	4.613-07	4.131-07	3.866-07
15	250	8.544-06	5.891-06	3.955-06	2.159-06	1.119-06	8.566-07	7.583-07	7.133-07	6.920-07	7.181-07

TABLE IX:

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
1	2	5.681-03	5.114-03	4.499-03	3.539-03	2.325-03	1.634-03	1.208-03	9.291-04	5.441-04	3.551-04
1	3	1.742-02	1.576-02	1.396-02	1.115-02	7.611-03	5.600-03	4.371-03	3.572-03	2.485-03	1.961-03
1	4	2.818-02	2.537-02	2.233-02	1.756-02	1.154-02	8.104-03	5.993-03	4.609-03	2.699-03	1.761-03
1	5	1.006+00	1.081+00	1.162+00	1.292+00	1.484+00	1.624+00	1.731+00	1.818+00	1.984+00	2.101+00
1	6	2.831-04	2.423-04	2.022-04	1.457-04	8.445-05	5.488-05	3.876-05	2.916-05	1.752-05	1.271-05
1	7	8.171-04	6.961-04	5.773-04	4.103-04	2.293-04	1.420-04	9.453-05	6.627-05	3.202-05	1.801-05
1	8	1.362-03	1.168-03	9.784-04	7.116-04	4.237-04	2.857-04	2.110-04	1.669-04	1.142-04	9.311-05
1	9	6.221-03	6.642-03	7.076-03	7.748-03	8.632-03	9.182-03	9.550-03	9.814-03	1.023-02	1.041-02
1	10	2.189-03	2.164-03	2.137-03	2.092-03	2.031-03	1.990-03	1.964-03	1.947-03	1.922-03	1.901-03
1	11	5.048-03	4.298-03	3.577-03	2.591-03	1.551-03	1.041-03	7.491-04	5.648-04	3.172-04	2.001-04
1	12	5.047-02	5.234-02	5.426-02	5.713-02	6.058-02	6.257-02	6.383-02	6.468-02	6.591-02	6.661-02
1	13	1.927-02	2.389-02	2.970-02	4.098-02	6.154-02	7.896-02	9.418-02	1.080-01	1.369-01	1.591-01
1	14	1.100-03	9.537-04	8.077-04	6.005-04	3.668-04	2.440-04	1.716-04	1.256-04	6.488-05	3.741-05
1	15	4.206-03	4.073-03	4.010-03	4.113-03	4.690-03	5.399-03	6.116-03	6.819-03	8.395-03	9.671-03
1	16	5.447-03	4.725-03	4.003-03	2.978-03	1.820-03	1.211-03	8.517-04	6.235-04	3.222-04	1.861-04
1	17	6.439-03	5.493-03	4.568-03	3.290-03	1.930-03	1.262-03	8.858-04	6.534-04	3.531-04	2.151-04
1	18	1.073-02	9.174-03	7.628-03	5.494-03	3.214-03	2.118-03	1.491-03	1.100-03	5.969-04	3.711-04
1	19	1.503-02	1.282-02	1.066-02	7.680-03	4.504-03	2.947-03	2.068-03	1.526-03	8.245-04	5.031-04
1	20	5.673-02	6.346-02	7.095-02	8.372-02	1.030-01	1.161-01	1.256-01	1.331-01	1.462-01	1.551-01
1	21	1.704-05	1.495-05	1.283-05	9.739-06	6.131-06	4.193-06	3.042-06	2.304-06	1.308-06	8.351-07
1	22	6.113-05	5.741-05	5.426-05	5.134-05	5.249-05	5.697-05	6.254-05	6.865-05	8.337-05	9.561-05
1	23	8.172-05	7.172-05	6.157-05	4.673-05	2.943-05	2.014-05	1.462-05	1.108-05	6.297-06	4.021-06
1	24	6.188-04	7.462-04	9.132-04	1.248-03	1.893-03	2.463-03	2.961-03	3.425-03	4.423-03	5.191-03
1	25	1.002-04	8.624-05	7.247-05	5.296-05	3.128-05	2.037-05	1.420-05	1.040-05	5.529-06	3.341-06
1	26	2.096-04	1.836-04	1.574-04	1.193-04	7.482-05	5.114-05	3.706-05	2.805-05	1.597-05	1.021-05
1	27	3.760-04	3.303-04	2.838-04	2.161-04	1.370-04	9.480-05	6.985-05	5.377-05	3.201-05	2.191-05
1	28	5.012-04	4.397-04	3.775-04	2.867-04	1.806-04	1.238-04	8.998-05	6.823-05	3.897-05	2.511-05
1	29	9.111-05	8.102-05	7.084-05	5.573-05	3.720-05	2.669-05	2.014-05	1.573-05	9.364-06	6.181-06
1	30	2.739-05	2.380-05	2.029-05	1.539-05	1.005-05	7.456-06	6.028-06	5.171-06	4.107-06	3.641-06
1	31	7.300-05	6.230-05	5.186-05	3.724-05	2.130-05	1.349-05	9.171-06	6.566-06	3.318-06	1.911-06
1	32	1.225-04	1.055-04	8.896-05	6.602-05	4.154-05	3.004-05	2.385-05	2.025-05	1.616-05	1.461-05
1	33	2.726-04	2.287-04	1.866-04	1.297-04	7.123-05	4.415-05	2.966-05	2.110-05	1.063-05	6.191-06
1	34	4.204-04	3.541-04	2.903-04	2.040-04	1.146-04	7.256-05	5.007-05	3.683-05	2.047-05	1.321-05
1	35	1.609-04	1.329-04	1.064-04	7.141-05	3.693-05	2.179-05	1.406-05	9.699-06	4.689-06	2.731-06
1	36	5.276-04	4.442-04	3.637-04	2.544-04	1.413-04	8.829-05	5.970-05	4.266-05	2.162-05	1.261-05
1	37	3.046-04	3.385-04	3.783-04	4.497-04	5.632-04	6.524-04	7.126-04	7.586-04	8.464-04	9.061-04
1	38	1.097-04	9.886-05	8.944-05	7.901-05	7.390-05	7.601-05	8.054-05	8.558-05	9.782-05	1.081-04
1	39	1.467-04	1.214-04	9.740-05	6.555-05	3.407-05	2.019-05	1.311-05	9.101-06	4.504-06	2.691-06
1	40	1.667-04	1.365-04	1.083-04	7.154-05	3.648-05	2.174-05	1.463-05	1.084-05	6.805-06	5.341-06
1	41	3.908-04	3.363-04	2.822-04	2.058-04	1.219-04	7.995-05	5.624-05	4.160-05	2.272-05	1.411-05
1	42	2.450-04	2.125-04	1.804-04	1.352-04	8.649-05	6.257-05	4.957-05	4.204-05	3.346-05	3.051-05
1	43	8.158-05	7.027-05	5.906-05	4.315-05	2.563-05	1.685-05	1.187-05	8.793-06	4.809-06	2.991-06
1	44	4.977-04	5.065-04	5.153-04	5.280-04	5.421-04	5.497-04	5.544-04	5.575-04	5.615-04	5.631-04
1	45	4.379-04	4.974-04	5.658-04	6.771-04	8.233-04	9.180-04	9.847-04	1.033-03	1.106-03	1.141-03
1	46	2.826-03	3.151-03	3.534-03	4.231-03	5.399-03	6.331-03	7.140-03	7.835-03	9.262-03	1.041-03
1	47	1.603-03	1.363-03	1.133-03	8.188-04	4.882-04	3.273-04	2.356-04	1.780-04	1.007-04	6.331-05
1	48	9.359-03	9.757-03	1.018-02	1.082-02	1.163-02	1.212-02	1.244-02	1.267-02	1.300-02	1.311-02
1	49	4.127-04	3.580-04	3.035-04	2.261-04	1.388-04	9.287-05	6.577-05	4.850-05	2.547-05	1.471-05
1	50	1.281-03	1.133-03	9.891-04	7.928-04	5.939-04	5.074-04	4.720-04	4.601-04	4.739-04	5.101-04
1	51	2.043-03	1.773-03	1.504-03	1.121-03	6.883-04	4.607-04	3.263-04	2.407-04	1.263-04	7.331-05
1	52	4.435-03	5.443-03	6.702-03	9.151-03	1.361-02	1.743-02	2.073-02	2.367-02	3.002-02	3.521-02
1	53	1.848-03	1.601-03	1.354-03	1.000-03	6.057-04	4.045-04	2.884-04	2.155-04	1.194-04	7.501-05
1	54	3.079-03	2.668-03	2.258-03	1.669-03	1.012-03	6.742-04	4.824-04	3.627-04	2.032-04	1.281-04
1	55	4.306-03	3.732-03	3.155-03	2.331-03	1.412-03	9.426-04	6.722-04	5.022-04	2.783-04	1.741-04
1	56	1.286-03	1.048-03	8.286-04	5.485-04	2.840-04	1.691-04	1.090-04	7.407-05	3.289-05	1.671-05
1	57	1.790-03	1.453-03	1.150-03	7.722-04	3.999-04	2.382-04	1.548-04	1.063-04	4.881-05	2.631-05
1	58	2.313-03	1.885-03	1.491-03	9.867-04	5.110-04	3.043-04	1.961-04	1.333-04	5.918-05	3.011-05
1	59	1.003-02	1.111-02	1.234-02	1.442-02	1.760-02	1.990-02	2.157-02	2.283-02	2.505-02	2.631-02
1	60	2.613-03	3.055-03	3.557-03	4.372-03	5.490-03	6.252-03	6.772-03	7.115-03	7.548-03	7.711-03

Table IX—*continued* ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
1	61	5.912-06	5.247-06	4.553-06	3.513-06	2.258-06	1.563-06	1.142-06	8.694-07	4.964-07	3.17-07
1	62	1.747-05	1.552-05	1.350-05	1.048-05	6.864-06	4.908-06	3.695-06	2.923-06	1.943-06	1.46-06
1	63	2.860-05	2.539-05	2.205-05	1.704-05	1.097-05	7.612-06	5.573-06	4.248-06	2.435-06	1.56-06
1	64	1.263-05	1.114-05	9.669-06	7.563-06	5.115-06	4.051-06	3.255-06	2.854-06	2.802-06	2.73-06
1	65	3.974-05	3.444-05	2.919-05	2.169-05	1.318-05	8.772-06	6.224-06	4.624-06	2.526-06	1.56-06
1	66	4.085-05	3.546-05	3.012-05	2.247-05	1.375-05	9.211-06	6.572-06	4.903-06	2.698-06	1.68-06
1	67	7.715-05	6.730-05	5.750-05	4.340-05	2.724-05	1.876-05	1.378-05	1.064-05	6.504-06	4.58-06
1	68	1.058-04	9.236-05	7.891-05	5.949-05	3.706-05	2.517-05	1.814-05	1.365-05	7.628-06	4.83-06
1	69	6.203-05	5.445-05	4.686-05	3.578-05	2.279-05	1.580-05	1.161-05	8.876-06	5.101-06	3.27-06
1	70	2.187-05	2.097-05	2.014-05	1.906-05	1.805-05	1.768-05	1.755-05	1.752-05	1.755-05	1.75-05
1	71	9.133-05	7.725-05	6.356-05	4.477-05	2.507-05	1.573-05	1.067-05	7.651-06	3.930-06	2.33-06
1	72	3.893-05	3.372-05	2.857-05	2.122-05	1.289-05	8.605-06	6.129-06	4.571-06	2.514-06	1.56-06
1	73	4.496-05	3.841-05	3.204-05	2.315-05	1.355-05	8.934-06	6.465-06	5.015-06	3.267-06	2.53-06
1	74	1.385-04	1.180-04	9.804-05	7.070-05	4.215-05	2.863-05	2.131-05	1.699-05	1.177-05	9.61-05
1	75	7.088-05	5.940-05	4.838-05	3.346-05	1.819-05	1.115-05	7.422-06	5.239-06	2.621-06	1.54-06
1	76	1.801-04	1.530-04	1.265-04	8.989-05	5.104-05	3.237-05	2.214-05	1.598-05	8.299-06	4.94-06
1	77	1.630-05	1.419-05	1.265-05	1.168-05	1.342-05	1.645-05	1.971-05	2.244-05	2.731-05	3.08-05
1	78	7.867-05	7.722-05	7.687-05	7.902-05	8.824-05	9.849-05	1.085-04	1.178-04	1.382-04	1.55-04
1	79	2.725-05	2.164-05	1.662-05	1.044-05	4.953-06	2.789-06	1.741-06	1.168-06	5.333-07	2.91-07
1	80	2.068-05	1.641-05	1.254-05	7.777-06	3.589-06	1.961-06	1.201-06	7.980-07	3.550-07	1.84-07
1	81	3.165-05	2.648-05	2.193-05	1.683-05	1.350-05	1.272-05	1.257-05	1.265-05	1.321-05	1.38-05
1	82	8.267-05	6.961-05	5.701-05	3.984-05	2.206-05	1.375-05	9.265-06	6.609-06	3.368-06	2.00-06
1	83	1.478-05	1.320-05	1.211-05	1.152-05	1.281-05	1.465-05	1.673-05	1.847-05	2.128-05	2.29-05
1	84	6.928-05	5.747-05	4.630-05	3.156-05	1.721-05	1.099-05	7.903-06	6.212-06	4.401-06	3.79-06
1	85	1.343-04	1.143-04	9.487-05	6.789-05	3.912-05	2.514-05	1.737-05	1.264-05	6.653-06	4.01-06
1	86	9.908-05	8.533-05	7.190-05	5.336-05	3.382-05	2.468-05	1.976-05	1.695-05	1.399-05	1.31-05
1	87	2.366-05	1.875-05	1.435-05	8.942-06	4.206-06	2.353-06	1.466-06	9.855-07	4.544-07	2.50-07
1	88	3.611-05	3.088-05	2.575-05	1.860-05	1.087-05	7.063-06	4.922-06	3.605-06	1.916-06	1.16-06
1	89	3.159-05	2.548-05	1.993-05	1.332-05	7.900-06	5.848-06	4.948-06	4.512-06	4.155-06	4.13-06
1	90	5.797-05	4.635-05	3.589-05	2.291-05	1.116-05	6.368-06	3.987-06	2.663-06	1.185-06	6.33-06
1	91	3.462-05	3.360-05	3.340-05	3.498-05	4.115-05	4.621-05	4.941-05	5.180-05	5.661-05	6.00-05
1	92	3.520-05	2.855-05	2.237-05	1.447-05	7.071-06	3.939-06	2.393-06	1.541-06	5.943-07	2.62-07
1	93	2.748-05	2.553-05	2.428-05	2.398-05	2.670-05	3.003-05	3.358-05	3.650-05	4.129-05	4.44-05
available on request											
10	296	1.686-06	1.202-06	8.202-07	4.171-07	1.461-07	6.578-08	3.299-08	1.752-08	4.327-09	1.51-09
10	297	4.551-05	3.606-05	2.766-05	1.748-05	8.538-06	4.970-06	3.205-06	2.209-06	1.046-06	5.82-06
10	298	8.956-06	6.613-06	4.744-06	2.758-06	1.233-06	6.726-07	4.065-07	2.633-07	1.095-07	5.56-07
10	299	9.659-06	7.588-06	5.954-06	4.241-06	3.200-06	3.045-06	3.142-06	3.159-06	3.120-06	3.37-06
10	300	1.532-05	1.474-05	1.483-05	1.610-05	1.919-05	2.147-05	2.289-05	2.388-05	2.517-05	2.59-05
10	301	1.882-05	1.437-05	1.060-05	6.226-06	2.714-06	1.434-06	8.532-07	5.485-07	2.189-07	1.03-07
10	302	9.049-05	7.290-05	5.687-05	3.676-05	1.836-05	1.070-05	6.868-06	4.707-06	2.201-06	1.19-06
10	303	4.906-05	4.082-05	3.385-05	2.625-05	2.157-05	2.116-05	2.164-05	2.224-05	2.365-05	2.50-05
10	304	1.050-04	1.132-04	1.245-04	1.479-04	1.900-04	2.229-04	2.500-04	2.727-04	3.128-04	3.36-04
10	305	5.762-05	4.962-05	4.176-05	3.063-05	1.819-05	1.191-05	8.351-06	6.143-06	3.290-06	2.01-06
10	306	1.682-04	1.441-04	1.206-04	8.798-05	5.230-05	3.447-05	2.431-05	1.797-05	9.650-06	5.85-06
10	307	1.021-04	8.976-05	7.788-05	6.171-05	4.511-05	3.768-05	3.397-05	3.213-05	3.085-05	3.07-05
10	308	1.112-04	9.756-05	8.388-05	6.388-05	4.038-05	2.782-05	2.033-05	1.548-05	8.818-06	5.61-06
10	309	1.227-04	1.195-04	1.174-04	1.171-04	1.236-04	1.314-04	1.384-04	1.453-04	1.605-04	1.70-04
10	310	1.020-03	1.052-03	1.085-03	1.136-03	1.203-03	1.246-03	1.274-03	1.297-03	1.338-03	1.36-03
10	311	2.017-04	1.691-04	1.381-04	9.642-05	5.369-05	3.382-05	2.309-05	1.669-05	8.767-06	5.33-06
10	312	9.589-05	7.929-05	6.368-05	4.310-05	2.274-05	1.368-05	8.977-06	6.270-06	3.081-06	1.80-06
10	313	2.593-08	1.519-08	9.232-09	3.869-09	1.028-09	4.231-10	2.072-10	1.150-10	3.730-11	1.46-11
10	315	1.279-04	1.057-04	8.492-05	5.762-05	3.100-05	1.929-05	1.332-05	9.941-06	6.074-06	4.64-06
10	317	4.983-08	3.145-08	1.890-08	8.161-09	2.827-09	1.018-09	3.918-10	1.774-10	5.422-11	2.06-11
10	319	4.799-08	2.751-08	1.817-08	8.597-09	2.449-09	1.022-09	4.328-10	1.913-10	7.553-11	3.40-11
10	320	6.457-08	4.130-08	2.532-08	1.145-08	4.261-09	1.533-09	5.391-10	2.049-10	6.887-11	2.67-11
10	322	1.913-04	1.610-04	1.320-04	9.281-05	5.232-05	3.323-05	2.281-05	1.654-05	8.688-06	5.27-06
10	323	1.612-04	1.391-04	1.180-04	8.963-05	6.098-05	4.825-05	4.177-05	3.828-05	3.513-05	3.49-05
10	324	6.383-05	5.424-05	4.495-05	3.220-05	1.871-05	1.216-05	8.499-06	6.251-06	3.367-06	2.07-06

Table IX—*continued* ...

i	j	Collision strength $\Omega$									
		Scattered electron energy (eV)									
		10	50	100	200	400	600	800	1000	1500	2000
10	325	7.484-05	6.608-05	5.964-05	5.481-05	5.803-05	6.500-05	7.160-05	7.719-05	8.797-05	9.600-05
10	326	7.419-07	5.150-07	3.378-07	1.611-07	5.424-08	2.467-08	1.325-08	7.877-09	2.463-09	9.740-10
10	327	8.313-07	5.825-07	3.882-07	2.079-07	9.187-08	8.816-08	8.961-08	3.965-08	5.175-08	2.740-08
10	328	1.240-06	9.506-07	7.301-07	5.183-07	4.394-07	4.076-07	4.397-07	4.619-07	4.924-07	6.110-07
10	329	1.587-06	1.124-06	7.615-07	3.832-07	1.341-07	6.096-08	3.106-08	1.685-08	4.272-09	1.480-09
10	330	1.086-06	8.136-07	5.939-07	4.060-07	2.326-07	2.946-07	3.394-07	1.452-07	2.119-07	1.190-07
10	331	1.485-06	1.091-06	7.524-07	3.888-07	1.309-07	5.177-08	2.496-08	1.445-08	4.776-09	2.220-09
10	332	1.677-03	1.839-03	2.024-03	2.342-03	2.851-03	3.237-03	3.548-03	3.811-03	4.337-03	4.750-03
10	333	1.908-06	1.373-06	9.469-07	4.891-07	1.722-07	7.645-08	3.761-08	1.954-08	4.720-09	1.650-09
10	334	2.379-06	1.848-06	1.447-06	1.054-06	8.886-07	8.211-07	8.849-07	9.289-07	9.914-07	1.230-07
10	335	4.279-05	3.332-05	2.502-05	1.512-05	6.820-06	3.742-06	2.330-06	1.585-06	7.662-07	4.400-07
10	336	5.524-05	4.327-05	3.278-05	2.029-05	9.988-06	6.212-06	4.580-06	3.746-06	2.859-06	2.580-06
10	337	8.155-06	5.936-06	4.162-06	2.277-06	9.135-07	4.739-07	2.865-07	1.901-07	8.335-08	4.320-08
10	338	9.501-06	7.074-06	5.158-06	3.125-06	1.776-06	1.432-06	1.363-06	1.345-06	1.302-06	1.270-06
10	339	1.514-05	1.399-05	1.352-05	1.399-05	1.618-05	1.794-05	1.908-05	1.988-05	2.093-05	2.150-05
10	340	1.857-05	1.407-05	1.028-05	5.935-06	2.514-06	1.305-06	7.671-07	4.893-07	1.922-07	8.800-08
10	341	1.061-04	8.539-05	6.656-05	4.295-05	2.137-05	1.242-05	7.942-06	5.426-06	2.510-06	1.330-06
10	342	9.394-05	7.491-05	5.793-05	3.719-05	1.867-05	1.107-05	7.211-06	4.989-06	2.351-06	1.290-06
10	343	1.073-04	1.040-04	1.032-04	1.075-04	1.234-04	1.390-04	1.528-04	1.649-04	1.873-04	2.000-04
10	344	1.236-05	1.015-05	8.419-06	6.638-06	5.721-06	5.827-06	6.201-06	6.462-06	6.645-06	6.660-06
10	345	1.767-05	1.312-05	9.501-06	5.652-06	2.626-06	1.455-06	8.816-07	5.686-07	2.319-07	1.170-07
10	346	1.908-05	1.468-05	1.091-05	6.481-06	2.862-06	1.512-06	8.916-07	5.654-07	2.169-07	9.900-08
10	347	2.785-05	2.656-05	2.636-05	2.801-05	3.268-05	3.627-05	3.856-05	4.016-05	4.230-05	4.350-05
10	348	5.421-05	4.826-05	4.381-05	4.047-05	4.241-05	4.680-05	5.057-05	5.351-05	5.876-05	6.300-05
10	349	7.880-05	6.411-05	5.055-05	3.326-05	1.703-05	1.006-05	6.494-06	4.449-06	2.043-06	1.070-06
10	350	2.400-04	2.663-04	2.995-04	3.627-04	4.699-04	5.509-04	6.166-04	6.713-04	7.693-04	8.270-04

TABLE X:

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	2	1.995-07	2.721-01	8.359-02	7.295-02	5.955-02	5.094-02	4.479-02	4.011-02	3.641-02
1	3	8.784-13	4.586-06	6.440-02	7.631-02	7.685-02	7.239-02	6.792-02	6.408-02	6.087-02
1	4	1.980-12	8.212-04	4.305-02	3.728-02	3.007-02	2.550-02	2.226-02	1.982-02	1.791-02
1	5			5.828-03	4.970-03	3.920-03	3.270-03	2.818-03	2.483-03	2.223-03
1	6	1.205-11	3.285-02	1.174-02	1.055-02	8.875-03	7.722-03	6.867-03	6.201-03	5.665-03
1	7			2.940-05	3.164-05	3.942-05	4.347-05	4.522-05	4.590-05	4.608-05
1	8	8.687-11	1.010+00	9.668-03	8.677-03	7.289-03	6.336-03	5.631-03	5.082-03	4.641-03
1	9	8.160-02	1.582+09	3.788-01	4.022-01	4.390-01	4.676-01	4.913-01	5.115-01	5.292-01
1	10	2.856-11	4.602-01	2.352-03	2.105-03	1.763-03	1.529-03	1.357-03	1.224-03	1.116-03
1	11	7.759-02	2.083+09	2.869-01	3.045-01	3.323-01	3.542-01	3.723-01	3.879-01	4.016-01
1	12			1.418-03	1.268-03	1.061-03	9.196-04	8.156-04	7.350-04	6.704-04
1	13	1.833-10	4.999+00	5.628-03	5.050-03	4.243-03	3.690-03	3.280-03	2.962-03	2.705-03
1	14	9.369-02	4.352+09	2.392-01	2.532-01	2.758-01	2.938-01	3.089-01	3.220-01	3.335-01
1	15			2.055-03	1.842-03	1.546-03	1.344-03	1.195-03	1.080-03	9.872-04
1	16	1.305-07	8.146+03	1.830-03	1.923-03	2.121-03	2.280-03	2.389-03	2.465-03	2.519-03
1	17	1.807-11	1.905+00	9.468-05	8.186-05	6.542-05	5.496-05	4.759-05	4.208-05	3.777-05
1	18			6.831-04	6.573-04	6.244-04	6.028-04	5.872-04	5.751-04	5.655-04
1	19			3.267-04	2.826-04	2.260-04	1.899-04	1.645-04	1.455-04	1.306-04
1	20			5.635-05	4.911-05	3.980-05	3.386-05	2.968-05	2.655-05	2.411-05
1	21			8.244-04	7.308-04	6.032-04	5.181-04	4.564-04	4.091-04	3.715-04
1	22	6.791-02	3.954+10	4.460-03	5.476-03	7.395-03	9.125-03	1.069-02	1.211-02	1.342-02
1	23	5.257-10	1.848+02	8.184-04	7.237-04	5.954-04	5.105-04	4.490-04	4.020-04	3.647-04
1	24	6.702-04	4.000+08	8.705-04	7.894-04	6.822-04	6.142-04	5.673-04	5.334-04	5.079-04
1	25	2.535-11	1.613+01	4.584-03	3.987-03	3.228-03	2.744-03	2.400-03	2.140-03	1.936-03
1	26	2.894-11	1.857+01	3.145-03	2.717-03	2.177-03	1.838-03	1.599-03	1.420-03	1.279-03
1	27	2.679-05	1.033+07	7.512-03	7.758-03	8.239-03	8.671-03	9.058-03	9.404-03	9.712-03
1	28			2.216-03	1.914-03	1.534-03	1.295-03	1.128-03	1.002-03	9.036-04
1	29	2.003-10	1.305+02	1.792-03	1.541-03	1.227-03	1.030-03	8.922-04	7.892-04	7.090-04
1	30			3.486-02	3.544-02	3.632-02	3.691-02	3.734-02	3.766-02	3.792-02
1	31	2.223-12	1.463+00	4.207-03	3.685-03	3.010-03	2.575-03	2.263-03	2.026-03	1.839-03
1	32	6.236-06	2.468+06	2.773-03	2.678-03	2.597-03	2.575-03	2.578-03	2.592-03	2.612-03
1	33			2.907-03	2.510-03	2.012-03	1.699-03	1.478-03	1.313-03	1.183-03
1	34	2.843-11	1.994+01	3.110-03	2.686-03	2.156-03	1.824-03	1.591-03	1.416-03	1.280-03
1	35	3.362-10	1.418+02	4.165-06	3.634-06	2.957-06	2.526-06	2.221-06	1.992-06	1.812-06
1	36			5.298-04	4.717-04	3.994-04	3.543-04	3.229-04	2.996-04	2.814-04
1	37			2.261-05	1.958-05	1.574-05	1.332-05	1.161-05	1.033-05	9.323-06
1	38	2.937-10	1.251+02	8.520-03	7.193-03	5.592-03	4.624-03	3.964-03	3.480-03	3.107-03
1	39			6.589-03	6.595-03	6.751-03	6.948-03	7.149-03	7.343-03	7.524-03
1	40	1.715-08	7.351+03	6.322-03	5.382-03	4.229-03	3.522-03	3.034-03	2.674-03	2.395-03
1	41			3.224-03	2.728-03	2.127-03	1.763-03	1.513-03	1.330-03	1.189-03
1	42	1.061+00	7.702+11	1.493-01	1.686-01	2.017-01	2.297-01	2.542-01	2.761-01	2.959-01
1	43	5.205-09	2.270+03	9.123-03	7.769-03	6.109-03	5.089-03	4.386-03	3.866-03	3.463-03
1	44			3.875-03	3.582-03	3.268-03	3.105-03	3.012-03	2.956-03	2.922-03
1	45	2.564-09	1.125+03	1.489-03	1.232-03	9.326-04	7.571-04	6.399-04	5.555-04	4.915-04
1	46	6.041-02	4.426+10	1.132-02	1.232-02	1.413-02	1.571-02	1.712-02	1.839-02	1.956-02
1	47			8.640-04	7.417-04	5.894-04	4.945-04	4.283-04	3.791-04	3.407-04
1	48			6.691-02	6.871-02	7.135-02	7.317-02	7.452-02	7.556-02	7.640-02
1	49	6.304-12	4.684+00	1.937-04	1.647-04	1.296-04	1.083-04	9.373-05	8.295-05	7.460-05
1	50	1.799-07	8.049+04	1.545-04	1.375-04	1.174-04	1.059-04	9.856-05	9.357-05	9.001-05
1	51	3.298-03	2.477+09	2.305-03	2.075-03	1.826-03	1.698-03	1.627-03	1.585-03	1.562-03
1	52			3.854-03	3.249-03	2.521-03	2.081-03	1.782-03	1.563-03	1.395-03
1	53	4.605-02	3.513+10	2.314-03	2.887-03	3.955-03	4.915-03	5.782-03	6.575-03	7.304-03
1	54			6.402-04	5.599-04	4.554-04	3.879-04	3.397-04	3.032-04	2.743-04
1	55			1.493-03	1.306-03	1.063-03	9.056-04	7.933-04	7.081-04	6.409-04
1	56	3.250-09	1.498+03	1.321-03	1.157-03	9.421-04	8.033-04	7.041-04	6.288-04	5.692-04
1	57			8.087-07	6.765-07	5.200-07	4.275-07	3.653-07	3.202-07	2.858-07
1	58			2.340-06	1.959-06	1.505-06	1.235-06	1.052-06	9.184-07	8.164-07
1	59	9.851-04	7.636+08	3.377-04	3.128-04	2.868-04	2.753-04	2.708-04	2.701-04	2.716-04
1	60	2.771-09	1.290+03	1.184-03	1.038-03	8.462-04	7.221-04	6.332-04	5.657-04	5.124-04
1	61			4.118-07	3.400-07	2.628-07	2.215-07	1.956-07	1.777-07	1.647-07



Table X—continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	62	1.782-01	1.418+11	6.436-03	8.366-03	1.201-02	1.537-02	1.849-02	2.138-02	2.403-02
1	63	1.067-09	5.101+02	4.254-04	3.722-04	3.018-04	2.582-04	2.227-04	1.911-04	1.644-04
1	64			1.183-05	1.233-05	1.315-05	1.379-05	1.434-05	1.480-05	1.518-05
1	65	1.549-09	7.475+02	5.307-04	4.660-04	3.795-04	3.253-04	2.812-04	2.419-04	2.088-04
1	66			8.741-05	7.673-05	6.253-05	5.366-05	4.645-05	4.001-05	3.458-05
1	67	7.794-02	6.313+10	2.819-03	3.668-03	5.277-03	6.766-03	8.149-03	9.430-03	1.061-02
1	68	5.959-11	2.899+01	6.977-05	6.135-05	5.012-05	4.310-05	3.737-05	3.226-05	2.794-05
1	69			6.618-05	5.799-05	4.721-05	4.050-05	3.505-05	3.018-05	2.608-05
1	70	5.209-07	2.557+05	1.967-04	2.107-04	2.342-04	2.536-04	2.706-04	2.854-04	2.980-04
1	71	4.959-14	4.056-02	4.804-05	4.236-05	3.479-05	3.002-05	2.613-05	2.264-05	1.971-05
1	72	2.265-12	1.895+00	3.326-03	2.872-03	2.290-03	1.937-03	1.653-03	1.400-03	1.189-03
1	73	3.107-08	1.561+04	4.083-03	3.526-03	2.813-03	2.380-03	2.033-03	1.723-03	1.464-03
1	74			2.840-03	2.452-03	1.955-03	1.653-03	1.411-03	1.195-03	1.015-03
1	75			6.749-07	5.676-07	4.363-07	3.615-07	3.025-07	2.495-07	2.052-07
1	76			2.157-06	1.815-06	1.398-06	1.160-06	9.722-07	8.034-07	6.623-07
1	77	1.647-09	8.338+02	1.113-07	1.085-07	1.050-07	1.033-07	1.019-07	1.006-07	9.951-08
1	78			4.250-04	3.669-04	2.925-04	2.474-04	2.112-04	1.789-04	1.519-04
1	79	4.361-13	3.697-01	1.143-05	9.975-06	8.087-06	6.934-06	6.005-06	5.178-06	4.487-06
1	80	1.500-07	7.633+04	1.860-03	1.610-03	1.290-03	1.096-03	9.409-04	8.024-04	6.867-04
1	81			3.470-03	2.995-03	2.387-03	2.018-03	1.722-03	1.458-03	1.237-03
1	82			4.309-07	3.545-07	2.638-07	2.152-07	1.775-07	1.433-07	1.147-07
1	83			2.028-03	1.746-03	1.386-03	1.169-03	9.955-04	8.404-04	7.109-04
1	84	7.245-07	3.736+05	5.251-04	4.884-04	4.465-04	4.259-04	4.105-04	3.965-04	3.851-04
1	85	6.828-13	5.875-01	2.595-05	2.231-05	1.768-05	1.491-05	1.268-05	1.069-05	9.032-06
1	86	5.088-05	2.631+07	9.502-03	1.054-02	1.218-02	1.347-02	1.458-02	1.556-02	1.638-02
1	87	6.628-14	5.726-02	1.773-04	1.527-04	1.213-04	1.023-04	8.710-05	7.353-05	6.220-05
1	88			1.042-04	1.063-04	1.096-04	1.121-04	1.141-04	1.158-04	1.172-04
1	89	1.097-04	5.752+07	1.944-02	2.167-02	2.517-02	2.791-02	3.027-02	3.234-02	3.410-02
1	90			9.751-04	8.414-04	6.703-04	5.666-04	4.833-04	4.091-04	3.471-04
1	91			1.732-06	1.725-06	1.780-06	1.867-06	1.949-06	2.020-06	2.080-06
1	92	6.364-12	5.635+00	4.065-05	3.504-05	2.790-05	2.362-05	2.018-05	1.710-05	1.452-05
1	93	4.486-11	2.396+01	5.774-05	4.901-05	3.814-05	3.175-05	2.666-05	2.213-05	1.836-05
1	94			3.036-05	2.872-05	2.752-05	2.755-05	2.778-05	2.798-05	2.822-05
1	95			2.862-05	2.450-05	1.930-05	1.619-05	1.370-05	1.148-05	9.635-06
1	96	6.087-12	3.260+00	3.599-04	3.093-04	2.449-04	2.062-04	1.752-04	1.475-04	1.245-04
1	97	5.764-13	5.165-01	1.074-02	1.202-02	1.404-02	1.561-02	1.696-02	1.816-02	1.917-02
		available on request								
20	454			9.911-07	1.037-06	1.206-06	1.414-06	1.612-06	1.786-06	1.941-06
20	455	1.219-07	4.969+04	2.635-06	2.271-06	1.804-06	1.524-06	1.299-06	1.098-06	9.291-07
20	456			7.287-06	6.493-06	5.387-06	4.671-06	4.081-06	3.555-06	3.112-06
20	457	1.060-14	7.237-03	1.054-04	1.066-04	1.088-04	1.108-04	1.126-04	1.140-04	1.152-04
20	458	6.790-13	4.644-01	3.931-06	3.386-06	2.693-06	2.284-06	1.957-06	1.665-06	1.421-06
20	459			1.858-05	1.597-05	1.267-05	1.070-05	9.127-06	7.714-06	6.530-06
20	460			2.487-05	2.129-05	1.679-05	1.412-05	1.199-05	1.008-05	8.488-06
20	461			2.148-05	2.153-05	2.191-05	2.249-05	2.304-05	2.350-05	2.391-05
20	462	2.074-11	8.535+00	1.242-04	1.213-04	1.214-04	1.252-04	1.296-04	1.338-04	1.381-04
20	463			1.141-04	9.706-05	7.588-05	6.347-05	5.359-05	4.476-05	3.739-05
20	464	1.697-03	1.164+09	5.745-06	5.040-06	4.098-06	3.509-06	3.031-06	2.604-06	2.245-06
20	465	4.434-10	1.825+02	2.004-05	1.696-05	1.318-05	1.098-05	9.240-06	7.679-06	6.378-06
20	466	6.656-07	2.741+05	1.507-05	1.283-05	1.022-05	8.810-06	7.724-06	6.750-06	5.947-06
20	467			2.335-05	2.049-05	1.668-05	1.431-05	1.238-05	1.065-05	9.205-06
20	468	2.044-12	1.405+00	3.445-04	3.896-04	4.667-04	5.329-04	5.931-04	6.484-04	6.986-04
20	469	2.045-10	8.431+01	8.462-06	7.425-06	6.093-06	5.299-06	4.663-06	4.095-06	3.620-06
20	471	8.417-09	3.479+03	1.606-04	1.612-04	1.625-04	1.639-04	1.651-04	1.661-04	1.668-04
20	472	5.705-02	3.932+10	4.382-04	5.243-04	6.779-04	8.158-04	9.434-04	1.062-03	1.172-03
20	473			6.928-08	5.498-08	4.325-08	3.900-08	3.491-08	2.925-08	2.251-08
20	474			3.612-08	2.689-08	1.780-08	1.349-08	1.032-08	7.403-09	4.984-09
20	475			7.667-08	5.724-08	3.810-08	2.882-08	2.196-08	1.572-08	1.061-08
20	476			4.164-08	3.361-08	2.438-08	1.676-08	1.008-08	4.159-09	*****
20	477			1.648-05	1.355-05	1.014-05	8.257-06	6.791-06	5.475-06	4.384-06

Table X—continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
20	478			2.898-05	3.102-05	3.464-05	3.770-05	4.038-05	4.272-05	4.471-05
20	479			6.452-06	5.200-06	3.792-06	3.044-06	2.468-06	1.948-06	1.517-06
20	480			7.294-06	6.168-06	4.992-06	4.437-06	4.029-06	3.656-06	3.350-06
20	481	2.027-08	8.397+03	1.955-06	1.678-06	1.323-06	1.111-06	9.421-07	7.907-07	6.641-07
20	482			4.634-06	4.649-06	4.774-06	4.917-06	5.044-06	5.147-06	5.226-06
20	483			3.986-06	3.190-06	2.306-06	1.839-06	1.481-06	1.158-06	8.911-07
20	484			6.887-07	5.297-07	3.653-07	2.831-07	2.213-07	1.654-07	1.193-07
20	485			8.535-07	6.733-07	4.879-07	3.963-07	3.277-07	2.653-07	2.138-07
20	486			2.494-05	2.099-05	1.620-05	1.343-05	1.124-05	9.282-06	7.655-06
20	487	6.702-12	2.781+00	1.270-05	1.060-05	8.089-06	6.654-06	5.525-06	4.515-06	3.677-06
20	488			1.655-05	1.377-05	1.046-05	8.601-06	7.143-06	5.838-06	4.757-06
20	489	2.323-14	1.608-02	2.438-05	2.072-05	1.622-05	1.355-05	1.143-05	9.541-06	7.968-06
20	490	1.240-11	5.153+00	2.219-05	1.978-05	1.692-05	1.534-05	1.412-05	1.304-05	1.216-05
20	491	6.203-05	4.296+07	7.807-06	6.693-06	5.297-06	4.458-06	3.786-06	3.187-06	2.689-06
20	492			1.066-05	9.797-06	9.192-06	9.220-06	9.349-06	9.453-06	9.568-06
20	493			3.793-04	4.108-04	4.623-04	5.043-04	5.417-04	5.754-04	6.052-04
20	494	9.102-04	6.318+08	3.514-08	2.590-08	1.705-08	1.278-08	9.631-09	6.780-09	4.454-09
20	495			4.132-08	3.147-08	2.156-08	1.558-08	1.078-08	6.479-09	2.873-09
20	496			5.887-08	4.586-08	3.471-08	3.033-08	2.647-08	2.167-08	1.633-08
20	497	1.067-14	4.451-03	6.713-08	4.988-08	3.304-08	2.489-08	1.886-08	1.340-08	8.945-09
20	498			7.161-06	5.751-06	4.173-06	3.339-06	2.698-06	2.119-06	1.640-06
20	499			4.811-08	4.024-08	3.032-08	2.059-08	1.171-08	3.845-09	*****
20	500			5.669-08	4.249-08	2.825-08	2.155-08	1.660-08	1.203-08	8.220-09
20	501			1.103-07	8.458-08	5.812-08	4.495-08	3.508-08	2.613-08	1.875-08
20	502			1.220-07	9.455-08	6.954-08	5.881-08	4.945-08	3.841-08	2.654-08
20	503			7.388-06	5.958-06	4.403-06	3.612-06	3.013-06	2.470-06	2.022-06
20	504			1.747-05	1.437-05	1.076-05	8.763-06	7.211-06	5.817-06	4.660-06
20	505			2.013-05	1.904-05	1.820-05	1.809-05	1.811-05	1.811-05	1.811-05
20	506			1.426-05	1.183-05	8.956-06	7.343-06	6.079-06	4.946-06	4.006-06
20	507			1.129-05	9.135-06	6.702-06	5.400-06	4.396-06	3.490-06	2.738-06
20	508			5.670-05	6.220-05	7.124-05	7.854-05	8.486-05	9.039-05	9.507-05
20	509			8.252-06	7.383-06	6.587-06	6.313-06	6.143-06	5.979-06	5.848-06
20	510			3.773-06	3.679-06	3.658-06	3.704-06	3.752-06	3.787-06	3.813-06
20	511			3.208-06	2.543-06	1.815-06	1.436-06	1.147-06	8.859-07	6.702-07
20	512	4.516-09	1.886+03	3.656-06	2.917-06	2.099-06	1.669-06	1.340-06	1.043-06	7.969-07
20	513	2.703-14	1.881-02	7.917-06	7.852-06	7.947-06	8.120-06	8.280-06	8.404-06	8.500-06
20	514			7.434-07	5.688-07	3.894-07	3.001-07	2.332-07	1.726-07	1.228-07
20	515			9.109-07	7.072-07	5.001-07	3.990-07	3.238-07	2.554-07	1.991-07
20	516	3.592-08	1.501+04	1.048-06	8.515-07	6.512-07	5.565-07	4.865-07	4.219-07	3.680-07
20	517			1.220-06	9.471-07	6.616-07	5.169-07	4.078-07	3.090-07	2.276-07
20	518			4.335-07	3.749-07	2.997-07	2.542-07	2.176-07	1.849-07	1.575-07
20	519			9.013-06	1.068-05	1.370-05	1.644-05	1.897-05	2.134-05	2.352-05
20	520	1.053-03	7.458+08	1.678-06	1.423-06	1.108-06	9.250-07	7.795-07	6.492-07	5.405-07
20	521	9.034-12	3.844+00	9.499-05	8.197-05	6.528-05	5.522-05	4.713-05	3.991-05	3.387-05
20	522	2.878-14	2.044-02	1.630-04	1.410-04	1.128-04	9.575-05	8.207-05	6.987-05	5.967-05
20	523	5.270-09	2.246+03	2.325-04	2.008-04	1.600-04	1.354-04	1.157-04	9.800-05	8.323-05
20	524			6.052-07	5.035-07	3.854-07	3.215-07	2.720-07	2.277-07	1.910-07
20	525			5.566-07	4.885-07	3.977-07	3.406-07	2.942-07	2.528-07	2.181-07
20	526			3.951-06	4.213-06	4.769-06	5.342-06	5.895-06	6.420-06	6.918-06
20	527	2.227-05	1.588+07	3.431-07	2.976-07	2.393-07	2.033-07	1.742-07	1.484-07	1.269-07
20	528	5.271-11	2.260+01	1.012-03	1.110-03	1.264-03	1.386-03	1.491-03	1.583-03	1.662-03
20	529	4.784-06	2.054+06	1.458-07	1.378-07	1.281-07	1.222-07	1.176-07	1.134-07	1.099-07
20	530	7.924-05	5.687+07	6.882-07	5.783-07	4.448-07	3.684-07	3.080-07	2.540-07	2.090-07
20	531	8.235-11	3.554+01	8.616-05	7.070-05	5.264-05	4.276-05	3.507-05	2.815-05	2.240-05
20	532	1.812-12	7.860-01	1.204-04	9.904-05	7.406-05	6.023-05	4.946-05	3.979-05	3.179-05
20	533			1.557-04	1.278-04	9.518-05	7.733-05	6.344-05	5.093-05	4.052-05
20	534			3.745-04	4.213-04	4.863-04	5.313-04	5.681-04	5.995-04	6.249-04
20	535			8.902-06	8.394-06	7.813-06	7.514-06	7.290-06	7.089-06	6.926-06
20	536	1.257-02	9.140+09	2.588-05	2.828-05	3.208-05	3.508-05	3.768-05	3.996-05	4.191-05
20	537	1.082-07	4.757+04	1.616-06	1.377-06	1.078-06	9.026-07	7.625-07	6.374-07	5.329-07

Table X—*continued* ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
20	538			3.261-06	2.843-06	2.296-06	1.959-06	1.685-06	1.442-06	1.237-06
20	539			7.781-08	6.343-08	4.876-08	4.199-08	3.709-08	3.261-08	2.895-08
20	540			9.894-06	9.576-06	9.252-06	9.149-06	9.090-06	9.034-06	8.992-06
20	541	3.242-08	1.434+04	3.112-06	2.736-06	2.237-06	1.923-06	1.666-06	1.438-06	1.246-06
20	542			2.228-06	1.997-06	1.676-06	1.463-06	1.287-06	1.131-06	9.982-07
20	543			7.264-07	6.559-07	5.602-07	4.986-07	4.483-07	4.040-07	3.670-07
20	544			4.312-07	3.807-07	3.121-07	2.678-07	2.315-07	1.994-07	1.725-07
20	545	1.172-14	8.684-03	7.369-07	7.609-07	8.232-07	8.919-07	9.565-07	1.015-06	1.067-06
20	546			8.678-07	7.471-07	5.944-07	5.028-07	4.294-07	3.637-07	3.087-07
20	547			1.444-06	1.191-06	8.922-07	7.276-07	5.991-07	4.835-07	3.874-07
20	548	9.335-11	4.187+01	4.052-06	4.304-06	4.691-06	4.984-06	5.230-06	5.437-06	5.603-06
20	549			3.868-06	4.046-06	4.335-06	4.566-06	4.760-06	4.922-06	5.050-06
20	550			2.367-06	1.935-06	1.435-06	1.163-06	9.511-07	7.607-07	6.023-07
20	551			3.604-07	4.372-07	5.724-07	6.870-07	7.890-07	8.801-07	9.600-07
20	552	5.788-11	2.604+01	8.485-08	7.072-08	5.353-08	4.381-08	3.617-08	2.934-08	2.366-08
20	553	5.498-05	4.123+07	3.129-08	2.624-08	2.156-08	1.970-08	1.841-08	1.717-08	1.610-08
20	554	5.712-08	2.572+04	5.912-08	4.737-08	3.427-08	2.735-08	2.205-08	1.726-08	1.329-08
20	555			2.338-05	2.616-05	3.049-05	3.388-05	3.680-05	3.937-05	4.155-05
20	556			4.874-07	4.084-07	3.123-07	2.576-07	2.145-07	1.759-07	1.436-07
20	557	7.979-12	3.609+00	1.091-06	1.148-06	1.233-06	1.298-06	1.351-06	1.396-06	1.432-06
20	558			1.466-07	1.173-07	8.471-08	6.748-08	5.427-08	4.236-08	3.252-08
20	559			2.722-07	2.285-07	1.816-07	1.587-07	1.418-07	1.264-07	1.138-07

TABLE XI:

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	2	3.683-07	2.871+00	1.899-01	1.966-01	1.862-01	1.717-01	1.591-01	1.486-01	1.400-01
1	3	3.261-05	2.691+05	1.523-02	1.389-02	1.192-02	1.052-02	9.472-03	8.649-03	7.982-03
1	4	1.404-06	5.983+03	2.130-02	1.936-02	1.648-02	1.445-02	1.292-02	1.172-02	1.074-02
1	5	2.090-11	6.194-02	1.277-02	1.160-02	9.875-03	8.655-03	7.737-03	7.015-03	6.430-03
1	6	2.173-10	2.061+00	2.356-02	2.140-02	1.824-02	1.600-02	1.431-02	1.299-02	1.191-02
1	7	1.421-01	2.022+09	6.756-01	7.173-01	7.821-01	8.325-01	8.741-01	9.097-01	9.409-01
1	8	1.126-01	5.238+09	3.874-01	4.101-01	4.459-01	4.743-01	4.980-01	5.184-01	5.364-01
1	9	1.900-01	1.007+10	5.924-01	6.271-01	6.822-01	7.261-01	7.628-01	7.944-01	8.224-01
1	10	1.103-01	2.981+09	3.437-01	3.632-01	3.943-01	4.192-01	4.400-01	4.580-01	4.739-01
1	11	6.767-11	6.494+00	9.835-04	8.565-04	6.903-04	5.836-04	5.080-04	4.511-04	4.065-04
1	12	7.770-11	8.860+03	3.932-03	4.216-03	4.850-03	5.283-03	5.544-03	5.706-03	5.811-03
1	13	9.541-08	3.586+03	3.137-03	3.211-03	3.466-03	3.644-03	3.744-03	3.797-03	3.826-03
1	14			2.886-03	2.839-03	2.771-03	2.724-03	2.689-03	2.662-03	2.640-03
1	15	1.092-10	6.431+03	1.894-03	1.934-03	2.029-03	2.119-03	2.186-03	2.235-03	2.270-03
1	16	5.113-02	5.616+10	5.364-03	5.699-03	6.485-03	7.295-03	8.082-03	8.833-03	9.547-03
1	17	1.320-11	1.585+01	4.599-02	4.590-02	4.576-02	4.569-02	4.565-02	4.562-02	4.560-02
1	18	1.998-10	2.358+07	2.110-02	1.993-02	1.852-02	1.773-02	1.726-02	1.696-02	1.677-02
1	19	1.246+00	8.101+11	1.872-01	2.043-01	2.350-01	2.618-01	2.857-01	3.073-01	3.270-01
1	20	2.224-08	9.649+03	3.363-02	3.017-02	2.593-02	2.340-02	2.172-02	2.052-02	1.963-02
1	21	3.551-11	4.677+01	3.057-03	2.687-03	2.200-03	1.887-03	1.664-03	1.495-03	1.362-03
1	22	5.257-11	4.802+03	3.861-03	3.383-03	2.755-03	2.351-03	2.063-03	1.845-03	1.674-03
1	23	3.057-11	1.351+01	6.840-05	5.987-05	4.868-05	4.146-05	3.631-05	3.242-05	2.935-05
1	24	3.146-12	4.326+00	1.080-01	1.110-01	1.151-01	1.180-01	1.201-01	1.218-01	1.232-01
1	25	2.212-11	3.171+05	6.155-04	5.455-04	4.563-04	4.011-04	3.634-04	3.359-04	3.149-04
1	26	7.384-02	1.046+11	5.071-03	5.758-03	7.105-03	8.362-03	9.525-03	1.060-02	1.161-02
1	27	3.442-02	2.442+10	4.317-03	4.402-03	4.707-03	5.073-03	5.454-03	5.831-03	6.198-03
1	28	1.200-01	1.706+11	5.481-03	6.677-03	8.902-03	1.091-02	1.273-02	1.439-02	1.593-02
1	29	7.729-02	5.500+10	4.295-03	4.994-03	6.335-03	7.570-03	8.705-03	9.753-03	1.073-02
1	30	9.246-09	4.388+03	2.659-03	2.359-03	1.951-03	1.679-03	1.480-03	1.328-03	1.207-03
1	31			8.124-06	6.905-06	5.401-06	4.480-06	3.847-06	3.380-06	3.020-06
1	32	2.124-03	1.533+09	1.517-03	1.380-03	1.204-03	1.096-03	1.023-03	9.729-04	9.364-04
1	33	3.626-04	5.303+08	1.291-03	1.153-03	9.652-04	8.410-04	7.515-04	6.834-04	6.297-04
1	34	3.908-04	2.863+08	1.417-03	1.266-03	1.062-03	9.264-04	8.289-04	7.549-04	6.965-04
1	35	3.767-09	1.843+03	1.009-03	8.975-04	7.444-04	6.415-04	5.665-04	5.087-04	4.625-04
1	36	4.688-01	3.467+11	1.838-02	2.309-02	3.186-02	3.977-02	4.696-02	5.355-02	5.965-02
1	37	8.158-10	4.040+02	2.691-04	2.426-04	2.067-04	1.828-04	1.655-04	1.523-04	1.418-04
1	38	6.598-12	4.163+05	7.248-03	6.365-03	5.207-03	4.459-03	3.927-03	3.525-03	3.209-03
1	39	1.523-07	7.683+04	8.597-03	7.532-03	6.130-03	5.225-03	4.580-03	4.092-03	3.707-03
1	40			6.913-03	6.052-03	4.920-03	4.188-03	3.667-03	3.272-03	2.961-03
1	41	8.900-02	1.352+11	3.132-03	3.973-03	5.553-03	6.988-03	8.299-03	9.504-03	1.062-02
1	42			4.838-06	4.124-06	3.247-06	2.709-06	2.338-06	2.064-06	1.851-06
1	43	2.642-12	4.066+00	2.248-03	1.964-03	1.593-03	1.355-03	1.185-03	1.057-03	9.566-04
1	44	2.840-14	3.857+05	4.777-03	4.197-03	3.441-03	2.956-03	2.613-03	2.355-03	2.153-03
1	45	4.298-06	2.207+06	8.114-03	7.242-03	6.120-03	5.412-03	4.916-03	4.547-03	4.260-03
1	46			2.781-03	2.427-03	1.966-03	1.669-03	1.459-03	1.300-03	1.175-03
1	47	2.206-12	9.177+07	1.952-02	2.145-02	2.451-02	2.688-02	2.879-02	3.039-02	3.175-02
1	48	6.989-05	3.603+07	1.309-02	1.398-02	1.546-02	1.665-02	1.762-02	1.844-02	1.915-02
1	49	1.505-05	7.787+06	4.167-03	4.246-03	4.424-03	4.592-03	4.744-03	4.879-03	5.000-03
1	50	1.196-12	1.009+06	9.575-04	8.975-04	8.260-04	7.853-04	7.596-04	7.422-04	7.299-04
1	51	9.514-14	1.479-01	1.176-04	1.058-04	9.043-05	8.064-05	7.372-05	6.852-05	6.445-05
1	52	4.243-12	6.616+00	2.104-02	2.166-02	2.255-02	2.317-02	2.365-02	2.403-02	2.434-02
1	53	4.523-11	3.094+06	2.115-03	1.978-03	1.813-03	1.719-03	1.659-03	1.618-03	1.589-03
1	54	3.010-04	1.606+08	4.611-02	5.095-02	5.860-02	6.451-02	6.928-02	7.327-02	7.667-02
1	55			9.240-04	8.079-04	6.562-04	5.585-04	4.891-04	4.367-04	3.954-04
1	56	6.269-12	8.704+07	1.668-02	1.836-02	2.102-02	2.308-02	2.475-02	2.615-02	2.734-02
1	57	1.927-14	3.115-02	5.614-04	5.338-04	5.002-04	4.804-04	4.673-04	4.580-04	4.511-04
1	58	4.519-02	7.572+10	1.537-03	1.880-03	2.549-03	3.173-03	3.752-03	4.290-03	4.792-03
1	59	5.940-04	4.981+08	1.130-03	1.042-03	9.305-04	8.634-04	8.201-04	7.910-04	7.713-04
1	60	5.742-09	3.214+03	1.813-03	1.633-03	1.377-03	1.201-03	1.070-03	9.687-04	8.871-04
1	61	5.679-02	4.768+10	1.673-03	2.062-03	2.838-03	3.571-03	4.256-03	4.895-03	5.493-03

Table XI—continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	62	1.716-02	2.929+10	1.503-03	1.628-03	1.877-03	2.110-03	2.328-03	2.530-03	2.720-03
1	63	1.057-04	1.841+08	3.384-05	3.166-05	2.911-05	2.780-05	2.713-05	2.684-05	2.678-05
1	64	4.122-06	3.596+06	3.933-05	3.528-05	2.961-05	2.575-05	2.291-05	2.072-05	1.897-05
1	65			2.431-05	2.164-05	1.796-05	1.548-05	1.368-05	1.229-05	1.118-05
1	66			5.658-03	4.937-03	3.998-03	3.397-03	2.971-03	2.651-03	2.399-03
1	67	8.161-05	4.831+07	1.212-02	1.301-02	1.450-02	1.569-02	1.668-02	1.752-02	1.824-02
1	68	7.911-13	4.992+07	8.147-03	8.767-03	9.791-03	1.061-02	1.129-02	1.186-02	1.236-02
1	69	3.772-05	2.257+07	7.064-03	7.289-03	7.726-03	8.113-03	8.453-03	8.751-03	9.016-03
1	70	1.045-02	1.895+10	3.395-04	4.124-04	5.569-04	6.932-04	8.206-04	9.396-04	1.051-03
1	71	4.526-13	8.222-01	1.301-03	1.170-03	9.967-04	8.853-04	8.060-04	7.460-04	6.989-04
1	72	6.206-13	3.436+07	6.209-03	6.561-03	7.167-03	7.666-03	8.086-03	8.446-03	8.760-03
1	73	6.200-03	5.640+09	2.552-04	2.925-04	3.698-04	4.451-04	5.166-04	5.842-04	6.481-04
1	74			3.819-05	3.347-05	2.719-05	2.312-05	2.023-05	1.804-05	1.633-05
1	75	1.455-12	2.683+00	1.091-04	9.716-05	8.080-05	6.985-05	6.188-05	5.575-05	5.087-05
1	76	3.090-12	2.192+04	1.868-04	1.669-04	1.396-04	1.214-04	1.081-04	9.796-05	8.986-05
1	77	5.823-09	3.589+03	1.984-04	1.768-04	1.471-04	1.272-04	1.126-04	1.014-04	9.250-05
1	78	8.523-11	5.262+01	5.502-05	4.864-05	4.006-05	3.443-05	3.037-05	2.728-05	2.484-05
1	79	2.703-03	2.504+09	9.920-05	1.133-04	1.438-04	1.742-04	2.033-04	2.310-04	2.573-04
1	80			1.623-04	1.448-04	1.207-04	1.044-04	9.245-05	8.324-05	7.588-05
1	81	2.037-12	3.790+00	5.894-05	5.269-05	4.402-05	3.817-05	3.389-05	3.059-05	2.794-05
1	82	3.899-13	7.983+03	1.180-04	1.057-04	8.890-05	7.763-05	6.943-05	6.312-05	5.809-05
1	83	4.488-12	2.791+00	1.498-04	1.335-04	1.111-04	9.606-05	8.507-05	7.661-05	6.986-05
1	84	4.634-13	1.668+04	1.113-04	1.002-04	8.604-05	7.722-05	7.119-05	6.683-05	6.354-05
1	85	1.253-08	7.885+03	1.028-04	9.591-05	8.720-05	8.201-05	7.859-05	7.621-05	7.448-05
1	86	1.050-12	5.319+04	8.988-05	8.900-05	8.919-05	9.039-05	9.189-05	9.345-05	9.496-05
1	87	7.027-13	1.345+00	4.083-04	4.152-04	4.249-04	4.320-04	4.375-04	4.419-04	4.457-04
1	88	5.699-13	1.528+03	5.715-05	5.020-05	4.093-05	3.493-05	3.067-05	2.747-05	2.495-05
1	89	6.689-05	6.487+07	1.738-04	1.512-04	1.225-04	1.048-04	9.252-05	8.353-05	7.663-05
		available on request								
15	161	1.274-13	3.859+04	1.866-04	1.801-04	1.730-04	1.704-04	1.687-04	1.671-04	1.659-04
15	162	4.972-15	4.941+01	9.193-05	8.048-05	6.526-05	5.589-05	4.830-05	4.152-05	3.583-05
15	163	9.447-14	1.253+02	4.969-05	4.341-05	3.508-05	2.995-05	2.580-05	2.209-05	1.898-05
15	164	2.907-04	1.369+08	5.688-05	5.860-05	6.276-05	6.736-05	7.178-05	7.590-05	7.974-05
15	165	3.556-12	1.256+00	3.263-05	2.802-05	2.215-05	1.872-05	1.598-05	1.353-05	1.148-05
15	166	7.110-05	5.029+07	4.268-05	3.987-05	3.688-05	3.574-05	3.503-05	3.441-05	3.398-05
15	167			1.203-04	1.074-04	9.135-05	8.233-05	7.522-05	6.879-05	6.339-05
15	168	2.850-06	1.345+06	7.940-05	7.941-05	8.061-05	8.250-05	8.427-05	8.575-05	8.698-05
15	169	6.709-12	2.376+00	1.329-04	1.398-04	1.514-04	1.609-04	1.692-04	1.764-04	1.825-04
15	170	3.612-11	1.281+01	2.462-04	2.618-04	2.878-04	3.096-04	3.286-04	3.453-04	3.596-04
15	171	2.194-03	1.038+09	6.513-05	5.559-05	4.376-05	3.698-05	3.161-05	2.679-05	2.276-05
15	172	3.921-15	1.819+05	3.925-04	4.133-04	4.549-04	4.958-04	5.343-04	5.698-04	6.026-04
15	173			4.974-04	5.249-04	5.760-04	6.232-04	6.658-04	7.038-04	7.372-04
15	174			7.257-04	7.826-04	8.757-04	9.521-04	1.019-03	1.078-03	1.128-03
15	175	1.486-11	5.287+00	1.722-04	1.466-04	1.149-04	9.650-05	8.194-05	6.891-05	5.804-05
15	176	1.696-06	6.039+05	2.237-04	2.118-04	1.985-04	1.927-04	1.885-04	1.845-04	1.811-04
15	177	1.687-14	4.689+05	1.441-04	1.206-04	9.205-05	7.582-05	6.303-05	5.156-05	4.202-05
15	178	1.468-10	5.230+01	2.053-04	2.195-04	2.435-04	2.639-04	2.819-04	2.978-04	3.115-04
15	179	1.716-03	8.149+08	3.446-04	3.546-04	3.726-04	3.887-04	4.027-04	4.146-04	4.245-04
15	180			3.763-04	3.763-04	3.868-04	4.043-04	4.221-04	4.389-04	4.550-04
15	181	6.370-05	4.543+07	3.129-04	3.430-04	3.867-04	4.183-04	4.446-04	4.672-04	4.856-04
15	182	2.705-13	8.756+05	1.162-04	1.021-04	8.480-05	7.521-05	6.775-05	6.109-05	5.560-05
15	183	3.799-09	5.423+03	5.257-05	4.461-05	3.464-05	2.884-05	2.423-05	2.011-05	1.667-05
15	184	1.514-02	7.209+09	2.198-03	2.380-03	2.703-03	2.994-03	3.262-03	3.508-03	3.733-03
15	185	2.391-03	1.710+09	5.564-04	5.952-04	6.616-04	7.196-04	7.720-04	8.196-04	8.621-04
15	186	9.921-04	1.500+09	7.649-05	8.162-05	9.268-05	1.041-04	1.150-04	1.254-04	1.352-04
15	187	8.517-13	3.141+05	1.011-04	9.326-05	8.318-05	7.755-05	7.316-05	6.924-05	6.602-05
15	188	1.382-12	1.571+05	1.509-03	1.519-03	1.538-03	1.559-03	1.577-03	1.593-03	1.605-03
15	189	5.450-13	8.359+02	3.753-04	3.583-04	3.427-04	3.402-04	3.405-04	3.409-04	3.422-04
15	190	1.656-15	3.359+01	5.816-05	5.133-05	4.222-05	3.671-05	3.230-05	2.839-05	2.515-05
15	191	5.610-04	4.369+08	1.571-03	1.642-03	1.779-03	1.913-03	2.036-03	2.150-03	2.253-03

Table XI–continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
15	192	5.099-03	2.648+09	8.745-04	8.812-04	8.932-04	9.065-04	9.184-04	9.282-04	9.361-04
15	193	2.885-14	1.129-02	3.018-05	2.606-05	2.139-05	1.900-05	1.717-05	1.551-05	1.413-05
15	194			4.483-05	4.209-05	3.951-05	3.865-05	3.811-05	3.756-05	3.710-05
15	195	5.899-14	8.899+04	1.416-04	1.258-04	1.084-04	1.003-04	9.441-05	8.899-05	8.452-05
15	196	1.043-06	4.093+05	2.662-04	2.616-04	2.636-04	2.719-04	2.805-04	2.877-04	2.941-04
15	197	3.665-04	2.930+08	7.151-05	6.759-05	6.392-05	6.328-05	6.335-05	6.357-05	6.411-05
15	198	1.792-03	9.556+08	1.173-04	1.165-04	1.204-04	1.282-04	1.366-04	1.450-04	1.534-04
15	199	9.215-04	1.475+09	9.884-05	1.073-04	1.244-04	1.410-04	1.566-04	1.709-04	1.840-04
15	200	3.423-03	2.742+09	3.116-04	3.600-04	4.486-04	5.281-04	6.007-04	6.670-04	7.267-04
15	201	3.988-03	6.439+09	2.655-04	2.832-04	3.200-04	3.575-04	3.938-04	4.283-04	4.613-04
15	202	5.295-14	5.356+04	9.944-05	1.006-04	1.035-04	1.067-04	1.098-04	1.124-04	1.147-04
15	203	1.549-13	1.046+05	2.095-04	2.178-04	2.320-04	2.445-04	2.556-04	2.653-04	2.736-04
15	204	6.120-07	2.502+05	2.434-04	2.456-04	2.524-04	2.609-04	2.689-04	2.759-04	2.821-04
15	205	1.890-14	1.890+04	1.070-04	9.653-05	8.285-05	7.473-05	6.824-05	6.245-05	5.760-05
15	206	4.130-14	4.149+05	5.671-05	5.849-05	6.235-05	6.630-05	6.996-05	7.323-05	7.613-05
15	207	1.284-13	1.856+05	2.247-04	2.320-04	2.498-04	2.695-04	2.881-04	3.050-04	3.203-04
15	208	2.820-05	1.552+07	6.750-05	6.487-05	6.262-05	6.234-05	6.237-05	6.232-05	6.232-05
15	209	5.008-11	2.067+01	8.833-05	8.605-05	8.470-05	8.538-05	8.625-05	8.690-05	8.744-05
15	210	5.308-13	2.203-01	1.973-04	1.789-04	1.565-04	1.442-04	1.346-04	1.259-04	1.186-04
15	211			3.093-04	3.093-04	3.130-04	3.189-04	3.245-04	3.290-04	3.327-04
15	212	9.007-04	7.492+08	2.114-04	2.041-04	1.989-04	2.005-04	2.035-04	2.065-04	2.100-04
15	213	6.849-03	3.798+09	8.831-04	9.206-04	9.992-04	1.080-03	1.157-03	1.230-03	1.297-03
15	219	7.324-06	1.272+07	1.361-05	1.297-05	1.234-05	1.217-05	1.211-05	1.207-05	1.207-05
15	228	4.294-13	1.409+06	3.778-05	3.405-05	2.910-05	2.612-05	2.373-05	2.160-05	1.982-05
15	229	2.413-13	1.077+06	2.125-04	2.069-04	1.994-04	1.955-04	1.925-04	1.896-04	1.872-04
15	236	4.907-04	4.324+08	1.310-04	1.235-04	1.157-04	1.132-04	1.117-04	1.105-04	1.097-04
15	237	7.034-03	4.133+09	5.020-04	5.194-04	5.555-04	5.921-04	6.263-04	6.574-04	6.856-04
15	242			3.631-07	2.827-07	1.998-07	1.613-07	1.329-07	1.063-07	8.405-08
15	243			4.479-07	3.526-07	2.551-07	2.111-07	1.802-07	1.527-07	1.311-07
15	247	2.965-13	5.022+04	4.932-05	4.302-05	3.601-05	3.267-05	3.021-05	2.795-05	2.610-05
15	248	1.392-08	6.156+03	8.287-05	7.895-05	7.646-05	7.721-05	7.840-05	7.936-05	8.028-05
15	249	7.788-15	3.446-03	5.359-06	4.285-06	3.110-06	2.527-06	2.086-06	1.682-06	1.345-06
15	250			6.712-06	5.396-06	3.962-06	3.249-06	2.711-06	2.219-06	1.809-06

TABLE XII:

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	2			5.049-03	4.672-03	4.154-03	3.669-03	3.192-03	2.821-03	2.525-03
1	3	4.835-05	3.173+05	1.558-02	1.447-02	1.295-02	1.154-02	1.015-02	9.068-03	8.208-03
1	4	5.669-11	2.367-01	2.505-02	2.318-02	2.061-02	1.820-02	1.584-02	1.400-02	1.253-02
1	5	2.666-01	6.641+09	1.103+00	1.140+00	1.219+00	1.295+00	1.373+00	1.438+00	1.493+00
1	6			2.327-04	2.131-04	1.877-04	1.631-04	1.355-04	1.160-04	1.008-04
1	7	4.846-10	2.139+01	6.676-04	6.098-04	5.347-04	4.620-04	3.804-04	3.227-04	2.776-04
1	8	6.542-10	1.767+01	1.123-03	1.031-03	9.108-04	7.951-04	6.650-04	5.733-04	5.018-04
1	9	1.497-07	4.958+03	6.800-03	6.963-03	7.319-03	7.662-03	8.028-03	8.307-03	8.536-03
1	10			2.180-03	2.146-03	2.117-03	2.091-03	2.070-03	2.051-03	2.036-03
1	11	7.746-11	8.391+01	4.116-03	3.779-03	3.344-03	2.922-03	2.432-03	2.090-03	1.822-03
1	12			5.331-02	5.378-02	5.515-02	5.648-02	5.801-02	5.912-02	6.001-02
1	13	5.533-01	6.425+11	2.371-02	2.799-02	3.680-02	4.518-02	5.285-02	6.005-02	6.662-02
1	14			9.236-04	8.489-04	7.503-04	6.559-04	5.528-04	4.780-04	4.188-04
1	15	3.592-02	4.185+10	3.975-03	4.025-03	4.279-03	4.519-03	4.692-03	4.916-03	5.146-03
1	16	2.424-08	1.696+04	4.575-03	4.205-03	3.718-03	3.251-03	2.741-03	2.370-03	2.077-03
1	17	6.595-12	7.969+00	5.270-03	4.827-03	4.256-03	3.703-03	3.074-03	2.631-03	2.283-03
1	18	3.219-08	2.334+04	8.802-03	8.062-03	7.106-03	6.178-03	5.130-03	4.392-03	3.813-03
1	19			1.229-02	1.126-02	9.931-03	8.643-03	7.173-03	6.141-03	5.327-03
1	20	4.552-04	3.394+08	6.490-02	6.889-02	7.688-02	8.438-02	9.160-02	9.758-02	1.026-01
1	21			1.457-05	1.342-05	1.191-05	1.045-05	8.915-06	7.777-06	6.875-06
1	22	3.744-04	4.906+08	5.604-05	5.510-05	5.564-05	5.615-05	5.598-05	5.678-05	5.795-05
1	23	1.356-11	1.071+01	6.990-05	6.441-05	5.710-05	5.015-05	4.278-05	3.733-05	3.300-05
1	24	2.114-02	2.855+10	7.324-04	8.630-04	1.140-03	1.403-03	1.642-03	1.871-03	2.083-03
1	25	3.663-12	4.984+00	8.313-05	7.634-05	6.723-05	5.854-05	4.891-05	4.202-05	3.659-05
1	26	3.497-14	4.792-02	1.787-04	1.648-04	1.461-04	1.282-04	1.092-04	9.525-05	8.415-05
1	27	4.418-09	3.638+03	3.215-04	2.968-04	2.636-04	2.318-04	1.981-04	1.732-04	1.535-04
1	28			4.280-04	3.950-04	3.501-04	3.077-04	2.625-04	2.291-04	2.026-04
1	29	3.811-14	5.307-02	7.928-05	7.371-05	6.593-05	5.854-05	5.084-05	4.503-05	4.038-05
1	30			2.298-05	2.126-05	1.904-05	1.690-05	1.449-05	1.279-05	1.146-05
1	31	8.069-12	1.135+01	5.983-05	5.476-05	4.812-05	4.173-05	3.453-05	2.943-05	2.544-05
1	32	1.948-08	1.647+04	1.014-04	9.356-05	8.338-05	7.355-05	6.234-05	5.453-05	4.843-05
1	33	3.033-10	2.571+02	2.176-04	1.984-04	1.738-04	1.503-04	1.224-04	1.032-04	8.823-05
1	34			3.371-04	3.079-04	2.709-04	2.347-04	1.923-04	1.630-04	1.401-04
1	35	1.070-09	9.124+02	1.253-04	1.137-04	9.945-05	8.548-05	6.837-05	5.690-05	4.796-05
1	36			4.234-04	3.861-04	3.390-04	2.931-04	2.395-04	2.025-04	1.736-04
1	37	1.227-06	1.057+06	3.434-04	3.672-04	4.152-04	4.603-04	5.021-04	5.381-04	5.688-04
1	38	3.029-04	4.375+08	9.524-05	9.203-05	9.001-05	8.790-05	8.393-05	8.236-05	8.163-05
1	39	2.288-10	1.985+02	1.145-04	1.040-04	9.102-05	7.822-05	6.266-05	5.221-05	4.407-05
1	40			1.279-04	1.160-04	1.016-04	8.737-05	6.944-05	5.767-05	4.851-05
1	41	1.874-09	1.639+03	3.240-04	2.973-04	2.619-04	2.282-04	1.906-04	1.638-04	1.427-04
1	42	6.010-05	8.768+07	2.052-04	1.892-04	1.687-04	1.491-04	1.271-04	1.115-04	9.940-05
1	43			6.783-05	6.214-05	5.479-05	4.776-05	3.994-05	3.434-05	2.994-05
1	44			5.138-04	5.134-04	5.185-04	5.237-04	5.307-04	5.353-04	5.391-04
1	45			5.110-04	5.471-04	6.100-04	6.691-04	7.273-04	7.739-04	8.120-04
1	46	2.973-02	4.452+10	3.189-03	3.426-03	3.921-03	4.394-03	4.844-03	5.248-03	5.611-03
1	47	3.319-11	6.415+01	1.304-03	1.196-03	1.059-03	9.251-04	7.692-04	6.606-04	5.750-04
1	48			9.938-03	1.007-02	1.040-02	1.071-02	1.106-02	1.131-02	1.153-02
1	49			3.466-04	3.189-04	2.820-04	2.468-04	2.082-04	1.803-04	1.582-04
1	50	2.122-03	4.190+09	1.100-03	1.030-03	9.460-04	8.659-04	7.742-04	7.122-04	6.657-04
1	51	1.068-08	1.266+04	1.716-03	1.579-03	1.397-03	1.222-03	1.032-03	8.934-04	7.839-04
1	52	1.613-01	3.192+11	5.407-03	6.333-03	8.244-03	1.006-02	1.173-02	1.330-02	1.473-02
1	53	2.383-12	4.758+00	1.551-03	1.423-03	1.256-03	1.097-03	9.232-04	7.973-04	6.984-04
1	54	6.647-09	7.964+03	2.583-03	2.372-03	2.096-03	1.830-03	1.540-03	1.331-03	1.166-03
1	55			3.612-03	3.317-03	2.928-03	2.557-03	2.152-03	1.858-03	1.628-03
1	56	6.135-05	7.403+07	9.772-04	8.895-04	7.810-04	6.725-04	5.334-04	4.426-04	3.716-04
1	57	1.891-16	2.282-04	1.351-03	1.235-03	1.088-03	9.397-04	7.464-04	6.210-04	5.225-04
1	58			1.758-03	1.600-03	1.404-03	1.210-03	9.596-04	7.961-04	6.685-04
1	59			1.133-02	1.199-02	1.332-02	1.458-02	1.578-02	1.679-02	1.764-02
1	60			3.148-03	3.416-03	3.894-03	4.342-03	4.775-03	5.122-03	5.404-03
1	61			5.142-06	4.748-06	4.216-06	3.711-06	3.194-06	2.803-06	2.492-06

Table XII—continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
1	62	1.001-07	2.212+05	1.521-05	1.407-05	1.253-05	1.108-05	9.588-06	8.462-06	7.570-06
1	63	7.161-12	9.531+00	2.490-05	2.300-05	2.041-05	1.798-05	1.549-05	1.360-05	1.210-05
1	64	3.017-05	6.720+07	1.085-05	1.008-05	9.077-06	8.119-06	7.088-06	6.346-06	5.769-06
1	65	8.399-13	1.880+00	3.332-05	3.065-05	2.709-05	2.369-05	1.996-05	1.726-05	1.513-05
1	66	4.697-13	1.054+00	3.434-05	3.161-05	2.796-05	2.447-05	2.066-05	1.790-05	1.572-05
1	67	1.427-09	1.922+03	6.530-05	6.022-05	5.345-05	4.698-05	3.997-05	3.485-05	3.081-05
1	68			8.971-05	8.265-05	7.326-05	6.428-05	5.458-05	4.749-05	4.187-05
1	69	1.484-13	3.347-01	5.298-05	4.896-05	4.353-05	3.833-05	3.279-05	2.869-05	2.544-05
1	70			2.087-05	2.039-05	1.995-05	1.953-05	1.904-05	1.871-05	1.846-05
1	71	2.956-12	6.688+00	7.381-05	6.734-05	5.914-05	5.116-05	4.196-05	3.556-05	3.055-05
1	72	8.239-11	1.119+02	3.259-05	3.001-05	2.653-05	2.319-05	1.954-05	1.690-05	1.482-05
1	73	2.563-10	3.482+02	3.685-05	3.382-05	2.981-05	2.597-05	2.161-05	1.855-05	1.616-05
1	74			1.129-04	1.035-04	9.166-05	8.004-05	6.669-05	5.741-05	5.015-05
1	75	4.944-11	6.734+01	5.647-05	5.142-05	4.507-05	3.889-05	3.159-05	2.659-05	2.268-05
1	76			1.465-04	1.338-04	1.176-04	1.019-04	8.397-05	7.139-05	6.154-05
1	77	1.220-09	1.666+03	1.310-05	1.303-05	1.387-05	1.455-05	1.454-05	1.506-05	1.566-05
1	78	5.829-04	1.327+09	7.609-05	7.693-05	8.087-05	8.456-05	8.730-05	9.062-05	9.394-05
1	79			1.984-05	1.802-05	1.580-05	1.355-05	1.047-05	8.532-06	7.022-06
1	80	6.688-10	9.148+02	1.504-05	1.361-05	1.191-05	1.018-05	7.829-06	6.348-06	5.199-06
1	81			2.468-05	2.319-05	2.183-05	2.032-05	1.788-05	1.652-05	1.549-05
1	82			6.624-05	6.051-05	5.311-05	4.590-05	3.748-05	3.168-05	2.714-05
1	83	2.808-07	3.844+05	1.243-05	1.240-05	1.301-05	1.349-05	1.343-05	1.375-05	1.409-05
1	84			5.422-05	4.938-05	4.346-05	3.760-05	3.042-05	2.564-05	2.193-05
1	85	9.311-10	1.278+03	1.096-04	1.003-04	8.824-05	7.661-05	6.335-05	5.404-05	4.673-05
1	86	4.085-05	9.347+07	8.206-05	7.559-05	6.746-05	5.958-05	5.058-05	4.431-05	3.943-05
1	87			1.717-05	1.556-05	1.366-05	1.170-05	9.011-06	7.330-06	6.018-06
1	88			2.968-05	2.718-05	2.395-05	2.082-05	1.730-05	1.481-05	1.285-05
1	89			2.352-05	2.150-05	1.926-05	1.695-05	1.370-05	1.170-05	1.016-05
1	90			4.268-05	3.879-05	3.402-05	2.924-05	2.275-05	1.864-05	1.543-05
1	91			3.273-05	3.344-05	3.588-05	3.800-05	3.920-05	4.069-05	4.199-05
1	92			2.660-05	2.408-05	2.105-05	1.800-05	1.412-05	1.159-05	9.620-06
1	93			2.452-05	2.461-05	2.584-05	2.687-05	2.713-05	2.788-05	2.863-05
1	94	6.190-07	8.529+05	6.393-04	6.466-04	6.666-04	6.859-04	7.067-04	7.223-04	7.352-04
1	95	6.415-15	1.475-02	1.281-05	1.160-05	1.012-05	8.663-06	6.812-06	5.599-06	4.656-06
1	96	2.137-06	2.950+06	3.739-05	4.194-05	5.114-05	5.967-05	6.702-05	7.375-05	7.953-05
1	97			1.047-04	1.139-04	1.310-04	1.468-04	1.610-04	1.732-04	1.834-04
1	98	1.339-02	3.087+10	9.501-04	1.026-03	1.185-03	1.337-03	1.481-03	1.611-03	1.729-03
1	99	1.535-11	3.668+01	5.233-04	4.803-04	4.247-04	3.711-04	3.081-04	2.643-04	2.299-04
1	100			3.057-03	3.102-03	3.211-03	3.316-03	3.431-03	3.518-03	3.590-03
1	101			1.523-04	1.402-04	1.240-04	1.086-04	9.180-05	7.956-05	6.989-05
1	102	3.318-04	8.000+08	4.659-04	4.318-04	3.880-04	3.458-04	2.993-04	2.663-04	2.405-04
available on request										
10	252			6.855-07	6.430-07	6.193-07	5.730-07	4.279-07	3.571-07	2.949-07
10	253			1.269-06	1.198-06	1.184-06	1.135-06	9.514-07	8.539-07	7.574-07
10	254			1.389-06	1.284-06	1.157-06	1.004-06	6.968-07	5.351-07	4.070-07
10	255			1.013-06	9.737-07	1.012-06	1.007-06	8.562-07	7.850-07	7.056-07
10	256			1.342-06	1.199-06	1.057-06	9.009-07	6.337-07	4.839-07	3.673-07
10	257			1.638-06	1.503-06	1.346-06	1.163-06	8.139-07	6.266-07	4.784-07
10	258			2.377-06	2.245-06	2.210-06	2.111-06	1.769-06	1.583-06	1.398-06
10	259			1.092-05	1.003-05	9.011-06	7.799-06	5.594-06	4.390-06	3.437-06
10	260			1.327-05	1.231-05	1.135-05	1.019-05	7.876-06	6.662-06	5.709-06
10	261			3.116-05	3.215-05	3.452-05	3.648-05	3.710-05	3.821-05	3.909-05
10	262			2.717-05	2.470-05	2.191-05	1.880-05	1.384-05	1.097-05	8.717-06
10	263			1.379-04	1.379-04	1.446-04	1.499-04	1.492-04	1.526-04	1.562-04
10	264			7.312-05	6.630-05	5.831-05	5.003-05	3.790-05	3.053-05	2.479-05
10	265			2.411-05	2.229-05	2.007-05	1.752-05	1.295-05	1.040-05	8.362-06
10	266			2.012-05	1.926-05	1.868-05	1.789-05	1.591-05	1.499-05	1.427-05
10	267			9.483-05	8.652-05	7.666-05	6.653-05	5.146-05	4.239-05	3.534-05
10	268	5.984-14	7.455-02	5.096-03	5.377-03	5.961-03	6.519-03	7.063-03	7.534-03	7.950-03
10	269			2.758-05	2.508-05	2.213-05	1.899-05	1.419-05	1.133-05	9.106-06



Table XII—continued ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
10	270	3.621-06	4.512+06	6.111-05	6.356-05	6.895-05	7.356-05	7.618-05	7.916-05	8.154-05
10	271			2.008-04	1.824-04	1.600-04	1.375-04	1.076-04	8.848-05	7.358-05
10	272			1.653-04	1.503-04	1.326-04	1.143-04	8.893-05	7.306-05	6.064-05
10	273			2.730-04	2.793-04	2.992-04	3.169-04	3.282-04	3.418-04	3.543-04
10	274	5.004-13	1.040+00	1.124-04	1.116-04	1.148-04	1.170-04	1.150-04	1.160-04	1.172-04
10	275	5.698-02	1.184+11	1.421-04	1.291-04	1.134-04	9.744-05	7.694-05	6.363-05	5.322-05
10	276	1.728-05	2.154+07	7.112-04	7.729-04	8.973-04	1.013-03	1.118-03	1.211-03	1.291-03
10	277			8.041-06	7.404-06	6.551-06	5.749-06	4.925-06	4.303-06	3.812-06
10	278	2.326-03	5.086+09	2.424-05	2.444-05	2.587-05	2.721-05	2.812-05	2.938-05	3.068-05
10	279	1.630-12	3.573+00	4.635-05	4.257-05	3.761-05	3.281-05	2.743-05	2.360-05	2.058-05
10	280	1.007-11	2.209+01	5.776-05	5.321-05	4.713-05	4.129-05	3.495-05	3.034-05	2.669-05
10	281	1.959-05	2.579+07	8.508-05	8.086-05	7.622-05	7.168-05	6.611-05	6.251-05	5.980-05
10	282			2.573-04	2.585-04	2.637-04	2.688-04	2.745-04	2.789-04	2.827-04
10	283	9.424-11	1.242+02	5.222-05	4.821-05	4.279-05	3.769-05	3.255-05	2.861-05	2.549-05
10	284	2.347-11	3.094+01	6.948-05	6.339-05	5.568-05	4.814-05	3.907-05	3.292-05	2.810-05
10	285			3.644-05	4.171-05	5.297-05	6.359-05	7.292-05	8.197-05	9.026-05
10	286	7.441-10	9.813+02	9.887-09	1.118-08	1.129-08	1.059-08	6.731-09	5.166-09	3.815-09
10	289			2.531-08	2.464-08	2.355-08	2.127-08	1.382-08	1.047-08	7.701-09
10	290			1.223-04	1.116-04	9.806-05	8.486-05	6.918-05	5.845-05	5.004-05
10	291			8.073-05	7.493-05	6.852-05	6.203-05	5.341-05	4.802-05	4.391-05
10	292			6.098-04	6.368-04	6.959-04	7.524-04	8.066-04	8.544-04	8.967-04
10	293			4.974-07	4.448-07	3.948-07	3.378-07	2.363-07	1.804-07	1.367-07
10	294			5.228-07	4.871-07	4.526-07	4.087-07	3.132-07	2.650-07	2.269-07
10	295			9.128-07	8.792-07	8.501-07	8.097-07	7.018-07	6.575-07	6.279-07
10	296			1.010-06	9.251-07	8.295-07	7.164-07	5.008-07	3.851-07	2.939-07
10	297			3.301-05	3.000-05	2.641-05	2.274-05	1.761-05	1.441-05	1.191-05
10	298			5.715-06	5.266-06	4.722-06	4.111-06	3.023-06	2.416-06	1.933-06
10	299			6.783-06	6.398-06	6.038-06	5.603-06	4.722-06	4.271-06	3.925-06
10	300			1.419-05	1.482-05	1.617-05	1.733-05	1.794-05	1.868-05	1.929-05
10	301			1.284-05	1.165-05	1.029-05	8.824-06	6.589-06	5.265-06	4.232-06
10	302			6.747-05	6.134-05	5.381-05	4.626-05	3.627-05	2.986-05	2.487-05
10	303			3.783-05	3.579-05	3.397-05	3.196-05	2.833-05	2.643-05	2.502-05
10	304	3.917-06	5.170+06	1.128-04	1.213-04	1.393-04	1.560-04	1.703-04	1.836-04	1.951-04
10	305	2.001-11	4.409+01	4.785-05	4.396-05	3.876-05	3.379-05	2.827-05	2.432-05	2.120-05
10	306			1.384-04	1.271-04	1.123-04	9.797-05	8.175-05	7.024-05	6.119-05
10	307	7.329-06	9.695+06	8.678-05	8.116-05	7.429-05	6.757-05	5.979-05	5.445-05	5.034-05
10	308	1.210-12	2.668+00	9.489-05	8.771-05	7.784-05	6.848-05	5.847-05	5.109-05	4.523-05
10	309	8.768-05	1.161+08	1.183-04	1.180-04	1.206-04	1.229-04	1.240-04	1.260-04	1.280-04
10	310			1.069-03	1.077-03	1.103-03	1.129-03	1.158-03	1.180-03	1.198-03
10	311	1.705-09	2.258+03	1.606-04	1.468-04	1.290-04	1.117-04	9.115-05	7.708-05	6.605-05
10	312			7.469-05	6.801-05	5.961-05	5.135-05	4.122-05	3.443-05	2.914-05
10	313	2.059-09	2.730+03	9.872-09	1.060-08	1.056-08	9.833-09	6.156-09	4.649-09	3.364-09
10	315			9.940-05	9.065-05	7.965-05	6.882-05	5.545-05	4.653-05	3.959-05
10	317			2.289-08	2.237-08	2.135-08	1.934-08	1.247-08	9.410-09	6.876-09
10	319			1.713-08	1.969-08	2.006-08	1.888-08	1.207-08	9.342-09	6.962-09
10	320			3.059-08	2.969-08	2.828-08	2.551-08	1.670-08	1.270-08	9.402-09
10	322			1.531-04	1.400-04	1.232-04	1.068-04	8.749-05	7.421-05	6.378-05
10	323			1.335-04	1.238-04	1.119-04	1.004-04	8.661-05	7.730-05	7.011-05
10	324			5.193-05	4.752-05	4.190-05	3.644-05	3.015-05	2.576-05	2.230-05
10	325			6.211-05	6.133-05	6.295-05	6.401-05	6.249-05	6.299-05	6.377-05
10	326			4.254-07	3.879-07	3.507-07	3.045-07	2.078-07	1.578-07	1.181-07
10	327			4.795-07	4.441-07	4.094-07	3.650-07	2.622-07	2.112-07	1.708-07
10	328			8.289-07	7.921-07	7.616-07	7.190-07	6.090-07	5.599-07	5.237-07
10	329			9.401-07	8.629-07	7.739-07	6.702-07	4.663-07	3.580-07	2.725-07
10	330			6.973-07	6.598-07	6.203-07	5.697-07	4.561-07	3.999-07	3.561-07
10	331			9.551-07	8.510-07	7.494-07	6.359-07	4.499-07	3.443-07	2.622-07
10	332			1.871-03	1.972-03	2.185-03	2.388-03	2.585-03	2.756-03	2.907-03
10	333			1.163-06	1.065-06	9.503-07	8.182-07	5.759-07	4.440-07	3.401-07
10	334			1.633-06	1.559-06	1.498-06	1.414-06	1.211-06	1.119-06	1.052-06
10	335			3.015-05	2.730-05	2.403-05	2.059-05	1.562-05	1.258-05	1.023-05

Table XII—*continued* ...

i	j	$gf$	$A$ $s^{-1}$	Effective Collision strength $\Upsilon$						
				0.5	1.0	2.0	3.0	4.0	5.0	6.0
10	336			3.928-05	3.570-05	3.159-05	2.731-05	2.106-05	1.728-05	1.434-05
10	337			5.070-06	4.658-06	4.169-06	3.611-06	2.596-06	2.039-06	1.599-06
10	338			6.105-06	5.690-06	5.212-06	4.651-06	3.579-06	3.010-06	2.565-06
10	339			1.328-05	1.367-05	1.465-05	1.544-05	1.564-05	1.609-05	1.647-05
10	340	6.092-09	8.081+03	1.247-05	1.133-05	1.001-05	8.595-06	6.364-06	5.060-06	4.040-06
10	341			7.908-05	7.184-05	6.295-05	5.413-05	4.240-05	3.489-05	2.903-05
10	342			6.886-05	6.265-05	5.518-05	4.760-05	3.714-05	3.056-05	2.541-05
10	343	7.645-14	1.014-01	1.013-04	1.033-04	1.103-04	1.165-04	1.202-04	1.249-04	1.293-04
10	344			9.280-06	8.888-06	8.593-06	8.205-06	7.327-06	6.912-06	6.603-06
10	345			1.137-05	1.052-05	9.446-06	8.230-06	6.108-06	4.912-06	3.961-06
10	346	1.879-12	4.155+00	1.318-05	1.194-05	1.054-05	9.035-06	6.784-06	5.436-06	4.383-06
10	347			2.557-05	2.645-05	2.850-05	3.023-05	3.102-05	3.212-05	3.301-05
10	348			4.566-05	4.502-05	4.597-05	4.653-05	4.534-05	4.549-05	4.581-05
10	349	4.234-07	5.620+05	5.977-05	5.433-05	4.764-05	4.099-05	3.243-05	2.685-05	2.250-05
10	350	4.429-02	9.798+10	2.679-04	2.901-04	3.356-04	3.781-04	4.160-04	4.501-04	4.794-04